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DEPARTMENT OF TRADE AND INDUSTRY

# Survey of Passenger Ships

Instructions to Surveyors

Volume I

LONDON

HER MAJESTY'S STATIONERY OFFICE

£1.80 net

DEPARTMENT OF TRADE AND INDUSTRY

# SURVEY OF PASSENGER SHIPS

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Under the provisions of the Transfer of Functions (Shipping and Construction of Ships) Order 1965 all functions exercisable by the Ministry of Transport relating, *inter alia*, to passenger ships were transferred to the Board of Trade. Subsequently, by the Secretary of State for Trade and Industry Order 1970, all the functions of the Board of Trade relating to such ships were transferred to the Secretary of State for Trade and Industry so as to be exercisable concurrently with the Board of Trade. All references in these *Instructions* to the Minister (or Ministry) of Transport should be read as references to the Secretary of State for Trade and Industry or the Department of Trade and Industry as the case may be.

The 1952 Merchant Shipping Rules and the 1953 Collision Regulations listed in paragraph 2 have now been superseded by the 1965 Rules and the 1965 Collision Regulations. The amendments made to the Merchant Shipping (Construction) Rules 1952 by the Merchant Shipping (Passenger Ship Construction) Rules 1965 are of a minor nature and consist largely of such requirements as appear to the Secretary of State to implement the provisions of the International Convention for the Safety of Life at Sea, 1960, relating to the construction of passenger ships. When these *Instructions* are revised the amendments will be included.



# PART I

## General

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### *Chapter I*

#### INTRODUCTORY

##### *1. Object of Instructions*

These Instructions are issued by the Ministry of Transport for the guidance of their Marine Surveyors in surveying passenger ships under the provisions of the Merchant Shipping Acts.

They also indicate to shipowners, shipbuilders and others concerned the procedure which the Department adopts for the survey of passenger ships, and the conditions under which Passenger and Safety Certificates and Passenger Certificates are issued.

These Instructions should be read in conjunction with the other volumes of the Ministry's Instructions to their Marine Surveyors on the subject of life-saving appliances, fire appliances, load line, radio, direction finders, lights, shapes and sound signals, and pilot ladders. Separate publications are also available covering the statutory provisions for tonnage measurement, crew accommodation, musters and drills and the marking, stowage and carriage of dangerous goods.

##### *2. Statutory Provisions*

The principal statutory provisions affecting passenger ships are contained in :

Sections 267-283 of the Merchant Shipping Act, 1894, as amended.

Section 12 of the Merchant Shipping (Safety and Load Line Conventions) Act, 1932.

The Merchant Shipping (Safety Convention) Act, 1949.

The Merchant Shipping (Construction) Rules, 1952.\*

The Merchant Shipping (Life-Saving Appliances) Rules, 1952.

The Merchant Shipping (Fire Appliances) Rules, 1952.

The Merchant Shipping (Musters) Rules, 1952.

The Merchant Shipping (Pilot-Ladders) Rules, 1952.

The Merchant Shipping (Closing of Openings in Hulls and in Watertight Bulkheads) Rules, 1952.

The Merchant Shipping (Radio) Rules, 1952.

The Merchant Shipping (Direction-Finders) Rules, 1952.

The Collision Regulations (Ships and Seaplanes on the Water) and Signals of Distress (Ships) Order, 1953.

##### *3. Definitions*

For the purposes of Part III of the Merchant Shipping Act, 1894, the expression "Passenger steamer" is defined in Section 267 of that Act and for the purposes of the Merchant Shipping (Safety and Load Line Conventions) Act, 1932, and the Merchant Shipping (Safety Convention) Act, 1949, in Section 26(2) of the 1949 Act.

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\* These are the most important Rules affecting passenger ships and are hereinafter referred to as "the Rules". They are reproduced at Appendix I. Parts II-VII of these Instructions correspond with and are to be read together with Parts II-VII of the Rules.

If Surveyors are in doubt whether a vessel is or is not a passenger steamer, the matter should be referred through the Principal Officer concerned to headquarters.

Under Section 26(1) of the Merchant Shipping (Safety Convention) Act, 1949, the expression "passenger" means any person carried in a ship, except

- (a) a person employed or engaged in any capacity on board the ship on the business of the ship,
- (b) a person on board the ship either in pursuance of the obligation laid upon the Master to carry shipwrecked, distressed or other persons, or by any reason of any circumstance that neither the Master nor the Owner nor the Charterer (if any) could prevent or forestall, and
- (c) a child under one year of age.

"International voyage" and "short international voyage" are defined in Section 36 of the Merchant Shipping (Safety Convention) Act, 1949.

"Going to sea". Ships should be regarded as going to sea when they go outside partially smooth waters (see Rule 2(2) and the First Schedule to the Rules).

Other essential definitions are in Rules 1(2) and 2(2) of the Rules.

#### *4. The Need for Passenger Certificates Annually*

Under Section 271 of the Merchant Shipping Act, 1894, every passenger steamer which carries more than 12 passengers shall

- (a) be surveyed once at least in each year, and
- (b) shall not ply or proceed to sea or on any voyage or excursion with any passengers on board unless it holds a valid passenger certificate issued by the Ministry of Transport after survey by a Ministry Marine Surveyor.

#### *5. Classes of Passenger Ships*

Passenger ships are divided into eight classes (Classes I, II, II(A), III, IV, V, VI and VI(A)), according to the voyages which they may undertake (see Rule 2(1) of the Rules).

#### *6. Powers of Surveyors*

Under section 725 of the Merchant Shipping Act, 1894 a Surveyor, in the execution of his duties, may go on board any passenger ship at all reasonable times and inspect it, or any part of it, or any of the machinery, boats, equipments or articles on board, or any certificate of the Master, mates or engineers; and, in consequence of any accident to the ship or for any other reason he considers it necessary, he may require the ship to be taken into dry dock for the purpose of surveying the hull.

Surveyors should take every opportunity of visiting passenger ships and, should they find on inspection that any of the requirements of the Merchant Shipping Acts are not complied with, the fact should be pointed out to the Master or officer in charge of the ship and a report forwarded through the Principal Officer to headquarters.

If any person hinders a Surveyor from going on board any ship or otherwise impedes him in the execution of his duties under the Merchant Shipping Acts, he renders himself liable for each offence, to a fine not exceeding five pounds.

Any case of hindrance must be reported to headquarters.

#### *7. Penalties*

The penalties for carrying passengers in excess of the numbers allowed by the Passenger Certificate are set out in Section 283 of the Merchant Shipping Act, 1894.

The penalties for carrying passengers in excess of twelve without a certificate are set out in Section 21 of the Merchant Shipping Act, 1906.

### **8. Applications for Survey—Fees Payable**

Applications for survey are to be made by the owners to a Mercantile Marine Office on form Surveys 6, together with the survey fees. The application must show whether a safety certificate is required in addition to a passenger certificate. Form Surveys 6 can be obtained from any Mercantile Marine Office.

The application form, showing whether the survey fee has been paid, will be passed to the Surveyor who is to carry out the survey. No survey should be started until the appropriate fee is paid.

The booklet "List of Fees and Expenses payable in connection with Ministry of Transport Surveys and other Mercantile Marine Services" may be obtained from H.M. Stationery Office or through any bookseller, or an official copy may be consulted at any Mercantile Marine Office.

### **9. Notice of Survey**

So that the survey may be taken in hand without delay, at least three days notice should be given. By giving notice when a ship requiring a certificate in the near future is undergoing repairs or is in dry dock, the owners may avoid the need to open up or dock the ship again at another and less convenient time. (See paragraph 59 about the notice required for surveys abroad.)

### **10. Owners' Representatives at Surveys**

A responsible person representing the owners should, if possible, be present when Surveyors make their inspection. If the owner does not instruct a responsible representative to be present, the Surveyor should proceed with the survey in his absence.

### **11. Written Statement of Repairs**

If, in the course of the survey of a passenger ship, any difference of opinion arises between the Surveyor and the owner or his representative as to the nature and extent of the repairs to be carried out, the case should be reported to the Principal Officer. In such cases a written statement of the nature and extent of the repairs which it is decided must be carried out before the Surveyor can issue his declaration should be given to the owner or his representative. A copy of the statement should always be kept in the office.

## **Chapter 2**

### **DECLARATIONS**

#### **12. Issue of Declarations**

Under Section 272 of the Merchant Shipping Act, 1894, the Surveyor should deliver to the owner a Declaration of Survey, provided he is satisfied on survey that he can with propriety do so.

Form Surveys 1A is to be used for ships of Classes I and II, form Surveys 1 (Launch) for small motor vessels of Classes V-VI(A), except those marked with a sub-division load line, and form Surveys 1 for all other passenger ships.

Separate forms Surveys 1B and Surveys 1C are used for surveys of radio-telegraph and radiotelephone installations respectively.

#### **13. Making out of Declarations**

The Surveyor must fill in the particulars for all the items he has surveyed and sign the Declaration. When a Surveyor undertakes only part of the full survey, he should delete from the Declaration those items which he has not examined and for which he is not prepared to hold himself personally responsible. All



deletions must be initialled. For surveys of parts of the ship which do not correspond to the heading shown in the Declaration, the Surveyor should insert a description of those parts he has examined. For a full survey, every item in the Declaration should be covered.

In no case should notes be inserted on the declarations which imply any doubt as to the strength or the efficiency of any portion of the hull, equipments or machinery of a ship for the period covered by the declaration. If a Surveyor is not fully satisfied with any part or parts of the ship under survey, he must either refuse his declaration (see paragraph 19) or refer the matter through his Principal Officer to headquarters for instructions.

#### *14. Incomplete Declarations*

When the survey of the ship is made up of two or more partial surveys, each Surveyor concerned will sign a declaration for the details which he has examined (see paragraph 13).

All previous incomplete declarations affecting a current survey must be sent to or called for by the Surveyor who is to carry out the next partial survey, and the Surveyor who completes the survey must attach to his declaration all the previous incomplete declarations made, and, before sending them to the owners, must ensure that the declarations taken together will cover the ship completely.

Incomplete declarations for the first and intermediate partial surveys should be clearly marked "Incomplete" and that for the final partial survey marked "Completing". The declarations covering the full survey should be numbered consecutively by the Surveyor completing the survey. The Surveyor completing the survey must make specific inquiries from the master and chief engineer or, in their absence, from some other responsible officer or official to check that the parts already surveyed have remained satisfactory since the survey. If they have not remained satisfactory or have been repaired, the Surveyor should ensure that any repairs made are satisfactory and that the parts are sufficient for the intended purpose and for the period for which the declaration is issued.

#### *15. Period covered by Declarations and Dry Docking*

The Surveyor must limit his declaration to the period for which the hull, machinery and equipment of the ship will, in his opinion, be sufficient for the service on which the ship is intended to be engaged. In no case should this period exceed 12 months. In the case of a complete or completing declaration, the period should not exceed 12 months from the last examination of the hull or underwater fittings in dry dock; no complete or completing declaration should be issued if the outside of the hull and underwater fittings have not been examined in dry dock by a Surveyor during the preceding 12 months.

Examinations of the outside of the hull in dry dock should normally be made in daylight. In exceptional cases, examinations may be made during the hours of darkness, but only if adequate artificial lighting is provided to the Surveyor's satisfaction. At every survey office a Dry-Docking Book is to be kept in which the date of each examination of the outside of the hull in dry dock is to be recorded. If the hull is not passed for the maximum period of twelve months, the reasons must be noted in the docking book, otherwise the entry will be taken to mean that the hull has been passed for twelve months. The repairs, renewals and alterations which are carried out from time to time in dry dock are also to be recorded in the docking book.

Only in exceptional cases should declarations be issued, for periods of less than 3 months for ships of Class 1, or less than 1 month for other ships, and then only after reference to headquarters.

## 16. *Short Declarations*

A declaration will be limited to the shortest period for which any part or parts of the hull, machinery and equipments have been found sufficient for the intended service. When a declaration is limited to a period of less than 12 months because part of the ship is deficient or insufficient, other parts may be found to be in good condition and sufficient for the intended service for the full 12 months. These parts need not be examined when the ship is again surveyed provided that the declaration is limited to the period for which the parts were found sufficient at the first survey. If a second short declaration of this kind is granted by the Surveyor who made the first examination, he should state on his declaration that he was and still is satisfied as the result of his earlier survey that the parts not examined at the second survey are sufficient for the further period for which he issues a declaration. If the second short declaration is to be granted by another Surveyor, he need not examine the parts in question if the Surveyor who carried out the first survey, on application from the second Surveyor, sends him a declaration covering them for a further period not exceeding 12 months from the date of the survey when the parts were examined at the first survey.

## 17. *Declarations covering Extensions of Certificates*

In exceptional circumstances e.g. where dry docking facilities for ships of Class I or Class II will not be available within 12 months from the date of the last outside examination, owners may request an extension of the passenger and safety certificate or passenger certificate as the case may be for a period not exceeding one month from the date of its expiry.

If in the opinion of the Principal Officer the request is justified he should instruct a Surveyor to visit the ship and if the Surveyor is satisfied with her condition he should issue a short declaration for a period of not more than one month from the date of expiry of the current certificate. At the same time the Principal Officer should forward to headquarters a report as to why he considered the owner's request was justified. This extension should normally be granted only to a passenger ship whose subsequent voyages will be of short duration and will permit a proper survey of the ship to be made in the United Kingdom when the period of extension expires.

## 18. *Plying Limits*

For Classes II-VI(A) the Surveyor should insert plying limits in his declaration. For Class III, these limits must not be outside the areas defined in Appendix III to these Instructions and for Classes IV and V not outside the appropriate areas as defined in the First Schedule to the Rules. If the Surveyor is of the opinion that for any reason the limits for any particular ship of Classes III, IV and V should be less extensive than those shown in Appendix III and in the First Schedule to the Rules, he should submit the case through his Principal Officer to headquarters. Similarly, any application for plying limits in these three Classes for areas which are not shown in Appendix III and in the First Schedule to the Rules should be referred to headquarters.

For Classes VI and VI(A), the plying limits must not exceed the distances defined in Rule 2(I) of the Rules. The maximum Class VI plying limits will generally be allotted to fully decked boats only. Open boats of this Class may be allowed to ply up to 5 miles from the starting point, but small open boats may, at the Surveyor's discretion, be limited to a plying distance of 3 miles from the starting point. If fitted with a foredeck not less than 8 feet in length and a W.C., a ship of Class VI may be allowed to ply up to 10 miles from the starting point.\*

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\* The Ministry's detailed requirements for ships of Class VI are set out in Circular 1704 (revised February, 1954), which is reproduced as Appendix VI to these Instructions and is obtainable separately from H.M.S.O., price 6d.



When an owner applies for a certificate to carry passengers in more than one set of these limits, the Surveyor should show all the limits in his declaration.

If a new ship is surveyed during construction, or the annual survey of an existing ship is made in a district other than that in which the ship is to ply, the Surveyor carrying out the survey is to consult the Principal Officer in the district in which the ship is to ply, informing him of the desired limits and find out whether any special factors are to be taken into consideration. The Surveyor is to forward an incomplete declaration and all relevant plans and particulars of the ship to the Principal Officer in the district in which the ship is to ply for allocation of the plying limits and completion of the survey of any other outstanding items. No additional fee should be charged in these cases.

Any application for a change in the plying limits of an existing ship or for additional limits is to be forwarded to headquarters. If the application is granted during the currency of a Passenger Certificate, the appropriate fee is to be charged.

### *19. Refusal of a Declaration*

When a Surveyor refuses to grant a declaration, he must immediately send a report to headquarters through his Principal Officer giving full reasons for his refusal.

### *20. Declarations, North Atlantic Trade*

Declarations must not be granted for ships intended for the North Atlantic passenger trade which have not hitherto been engaged in that trade, without first referring each case to headquarters for instructions.

### *21. Procedure in Special Cases*

When a request is received for the survey of a ship of which the Surveyor has incomplete knowledge, he should apply to Headquarters for any relevant files to make himself familiar with any special features to be associated with the survey. When issuing his declaration on completion of the survey, the Surveyor should report to headquarters on any such special features and make any recommendations he may consider appropriate.

### *22. To whom Declarations are to be sent*

When completed, so far as it relates to the particulars to be furnished by the Surveyor, the declaration form Surveys I, Surveys IA or Surveys I (Launch), together with form Surveys IB or Surveys IC where applicable, is to be given or posted to the owner of the ship or his agent, who must send it to headquarters.

Simultaneously with the issue of the declaration, the Surveyor must send to headquarters, on form Surveys 133, a report that the declaration has been issued.

In the case of ships of Classes V, VI and VI(A), an undertaking on form Surveys 134 must be signed by the owner and witnessed before the declaration is handed or sent to him. The form of undertaking, when completed, must either be attached to the declaration or sent direct to headquarters. Passenger certificates will not be issued for these ships unless the form of undertaking, duly signed and witnessed, has been received by the Ministry.

### *23. Information to be sent to the Police*

As soon as any ship making voyages within the limits defined for Classes III to VI(A) and carrying passengers appropriate to those limits has been surveyed for a passenger certificate and a declaration issued, a notification on form Surveys 130 is to be sent by the Principal Officer to the chief constables of county or county borough (in Scotland, burgh) police forces in whose districts

the ship is allowed to ply. Additionally, in the case of county police forces, a copy of the notification is to be sent to superintendents of police in the particular districts affected.

#### **24. *Information sent to Local Authorities***

Copies of passenger certificates of ships of Classes V and VI are sent from headquarters to local authorities on request so as to aid the control of these craft.

#### **25. *Action on Completion of Survey***

When a Surveyor has completed his survey and issued a declaration he should send all the plans and papers relating to the survey to headquarters for final examination and recording. If there is a form B.H.1 (see paragraph 67(a)(2)(b) of Part II) for the ship the form should be obtained at each annual survey and all particulars for which spaces are provided should be properly entered; this should include a brief report of any important structural alterations, including the reasons for them. The Surveyor or Surveyors concerned should sign the form where indicated and return it to the Chief Ship Surveyor. The report on the survey should state whether there is any permanent ballast in the ship, its total amount and distribution, and whether any has been added or removed during the survey.

Complete copies of all declarations issued must be kept in the Survey Office. Relevant particulars of the survey must also be recorded on Survey forms 7, 8, 8A and B.H.1

### ***Chapter 3***

## **PASSENGER AND SAFETY CERTIFICATES**

#### **26. *Passenger Certificates***

Under the Merchant Shipping Acts a passenger certificate may be issued for a passenger ship if the declaration received at Headquarters shows that the ship complies with the construction rules, rules for life-saving appliances, fire appliances rules, radio rules, rules for direction-finders and other relevant provisions of the Merchant Shipping Acts which are applicable to the ship and the voyages she is to be engaged on, and that she is properly provided with the lights, shapes and means of making sound signals required by the collision regulations.

#### **27. *Safety Certificates***

In order to comply with the provisions of the International Convention for the Safety of Life at Sea, 1948, (to which the Merchant Shipping (Safety Convention) Act, 1949, gives effect) every passenger ship registered in the United Kingdom which is to be engaged on international voyages, i.e. ships of Classes I and II, must also be issued with a safety certificate certifying that the ship complies with the standards laid down in the Safety Convention. The requirements with which a ship of Class I or Class II must comply in order to be issued with a safety certificate are included in the requirements for the issue of a passenger certificate. If, therefore, from the declaration of survey, a ship of Class I or Class II qualifies for the issue of a passenger certificate, she will also qualify for the issue of a safety certificate.

A ship which is to be engaged on international voyages and which complies with the rules and other provisions of the Merchant Shipping Acts applicable to ships of Class I will be issued with a general safety certificate, and any ship

which is to be engaged on short international voyages and complies with the rules and other provisions of the Merchant Shipping Acts applicable to ships of Class II will be issued with a short voyage safety certificate.

### **28. *Exemption Certificates and Qualified Safety Certificates***

The International Convention for the Safety of Life at Sea, 1948, provides that in certain circumstances a new ship of Class I or Class II may be exempted from certain requirements of the Convention, and in that case should be issued with an Exemption Certificate and a Qualified Safety Certificate. These provisions have been brought into force for U.K. registered ships by the Merchant Shipping (Safety Convention) Act, 1949. A ship which qualifies for exemption under these conditions will be issued with an Exemption Certificate stating the requirements of the Convention from which it is exempt, and that the exemption is conditional upon the ship

- (i) plying only on the voyages, and
- (ii) being engaged only in the trades, and
- (iii) complying with any other conditions specified in the Certificate.

In addition a Qualified Safety Certificate will be issued, showing that the ship complies with the rest of the requirements of the Safety Convention.

Instructions will be issued from headquarters in any case where an Exemption Certificate is required.

### **29. *Forms of Safety and Exemption Certificates***

The forms of safety and exemption certificates to be issued to passenger ships are prescribed by the Safety Convention and models of these certificates are given in Appendix IV to these Instructions. The particulars inserted in the certificates must be in Roman characters and Arabic figures.

### **30. *Combined Passenger and Safety Certificates***

For passenger ships registered in the United Kingdom the safety certificate will be issued in a form combined with the passenger certificate. The passenger certificate part will certify that the provisions of the Merchant Shipping Acts relating to the survey of passenger ships have been complied with and will show the number of passengers which may be carried in the ship. The safety certificate part will give the particulars required by the Safety Convention.

### **31. *Classes of Certificates***

The following passenger and safety certificates are issued:

#### **(1) *Combined Passenger and Safety Certificates***

- (a) Form P. & S. 1 for ships of Class I.
- (b) Form P. & S. 2 for ships of Class II.

#### **(2) *Passenger Certificates***

Passenger Certificates for ships of Classes II(A) to VI(A) are different forms appropriate to each Class of ship. The heading of each form indicates the Class. A ship may hold more than one passenger certificate if appropriate. For example, the same ship may ply in smooth waters with 500 passengers and within Class VI limits with 250 passengers. In that case it must have both a Class V and a Class VI certificate.

### **32. *Issue of Passenger and Safety Certificates***

Passenger certificates and combined passenger and safety certificates will be sent in duplicate from headquarters to the Mercantile Marine Office named on the back of the declaration, and the master, owner or agent will be advised that



they have been despatched. The Superintendent of the Mercantile Marine Office will deliver the certificates to the master, owner or agent upon his applying for them at that Office, and paying any balance of fees outstanding.

### *33. Duration of Certificates*

Passenger and safety certificates and passenger certificates may not, except as stated below, be in force for more than one year from the date of their issue, or for more than the time specified in the certificates if this is less than one year, or after notice is given to the owner, master or agent of the ship that the Minister has cancelled the certificate. An exemption certificate must be in force for the same period as the corresponding qualified safety certificate.

If a ship of Class I is absent from the United Kingdom on the date her passenger certificate expires, the Minister or any person authorised by him may grant an extension of the certificate for a period, but not exceeding five months from that date, to allow the ship to complete her return voyage to the United Kingdom.

### *34. Posting up of Certificates*

The owner or master of every ship required to have a passenger certificate or a passenger and safety certificate must, on the receipt of the certificate by him or his agent, have one of the duplicates posted up in some conspicuous place on board the ship so as to be legible to all persons on board while the certificate remains in force and the ship is in service (see Section 281 of the Merchant Shipping Act, 1894, for penalties for non-compliance).

### *35. Carriage of Deck Passengers*

If it is desired to carry deck passengers during some part of the voyage, an application to this effect must be made when the ship is under survey for the passenger and safety certificate.

### *36. Issue of Safety Certificates by another Government*

The Minister may request the government of another Safety Convention country to issue a safety certificate or qualified safety certificate and exemption certificate for a passenger ship registered in the United Kingdom, and any such certificate containing a statement that it has been so issued, will have effect as if it had been issued by the Minister and not by the Government of that country.

### *37. Modification of an existing Passenger and Safety Certificate*

If the life-saving appliances on a ship of Class I or II are reduced for a limited period below the standard shown on the certificate (because for example, one lifeboat is disembarked for repairs) the master may make application to the Principal Officer for a memorandum modifying the number of passengers who may be carried to correspond with the reduced life-saving appliances. The application should be made on Form P. & S. Memo. No. 1, and provided he is satisfied that it is proper to do so, the Principal Officer (or a senior Surveyor holding the appropriate authority from the Minister) should issue a memorandum on Form P. & S. Memo. No 2 stating the total number of passengers to be carried on the ship on that voyage and the consequent modifications which may be made for the purpose of that voyage in the particulars of life-saving appliances stated in the certificate. The memorandum must be annexed to the certificate.

The Memorandum is to be returned to the Office of issue at the end of the voyage to which it relates and if it is not so returned the master of the ship will be liable to a fine not exceeding £20 (see Section 12 of the Merchant Shipping (Safety and Load Line Conventions) Act, 1932).

### 38. *Passenger Ships not normally engaged on International Voyages*

Where a passenger ship registered in the United Kingdom, not normally engaged on international voyages, is required to undertake a single international voyage, the Minister may, if he is of the opinion that the ship complies with safety requirements that are adequate for that voyage, exempt the ship from any of the safety requirements imposed by or under the Merchant Shipping Acts. All applications for this concession must be referred to headquarters. If the application is granted, the passenger certificate, if any, will be withdrawn and a safety certificate or an exemption certificate and a qualified safety certificate or qualified short voyage safety certificate, as the case may be, combined with a passenger certificate will be issued in respect of the ship applicable only to the single international voyage being undertaken. On completion of the voyage in question, the passenger and safety certificate or qualified safety certificate and the exemption certificate are to be returned to the Ministry and the original passenger certificate reissued, if still in force.

### 39. *Clearance*

The master of every ship requiring clearance must produce to the officer of Customs from whom a clearance is demanded the certificate or certificates required to be in force when the ship proceeds to sea; a clearance will not be granted and the ship may be detained, until production of the certificate(s).

Special instructions have been issued to Customs officers about the production of certificates by ships requiring clearance. If the necessary certificates are not produced, the case may be referred by the Customs officer concerned to the Surveyors for advice whether clearance should be granted, and separate instructions have been issued to Surveyors on this subject.

If it comes to the notice of a Surveyor that a ship, not requiring clearance, attempts to ply or proceed to sea without the requisite passenger certificate being in force, he should detain the ship and report the case to headquarters for instructions.

### 40. *Obligation to report Damage or Alterations (Section 425 of the Merchant Shipping Act, 1894)*

The owner or master of a passenger ship registered in the United Kingdom, for which a passenger certificate or a passenger and safety certificate is in force must, as soon as possible after any damage is sustained to, or alteration is made in, the ship's hull, main or auxiliary machinery, or equipments, including the renewal of any part, affecting the seaworthiness of the ship, give written notice to the Ministry containing full particulars of the damage, alteration or renewal. If such notice is not given, the owner or master of the ship is liable to a fine not exceeding fifty pounds. (It will obviously be to the advantage of owners and masters if prior notice is given to the Ministry when damage is to be repaired or alterations or renewals are to be made in order that a Surveyor may be present while the work is in progress.)

### 41. *Accidents and Damage (including Failures)*

When the Ministry is informed that a passenger ship has sustained damage a full report from the Surveyor will be called for. If the Surveyor learns of the damage from another source, he should, unless satisfied that the matter has already been reported to headquarters, ascertain from the master or other responsible officer connected with the ship, whether the damage was reported immediately after the accident as required by Section 425 of the Merchant Shipping Act, 1894. If the required report has not been made, the Surveyor must ask for an explanation from the master or other responsible officer and forward it with his report to headquarters. The Surveyor making the report should find



out the extent of the damage but, in doing so, he should not make any change in the position or condition of things on board which might affect any legal evidence if an enquiry into the case is made. He should report immediately to headquarters the result of his examination, stating whether, in his opinion, the ship is rendered inefficient or unseaworthy in hull, equipments or machinery, and whether the passenger certificate or passenger and safety certificate should be cancelled or temporarily withdrawn (see the next paragraph).

If any part of the ship is flooded, the direct cause is to be stated and a sketch forwarded showing the position of the watertight bulkheads, the compartments flooded, the draught and trim before and after flooding, the nature of the loading of the flooded compartments, the leakage through the bulkheads, and whether the latter were shored or not. Any defective action of watertight doors, valves and other means for closing the openings in the bulkheads and ship's sides, is also to be reported.

#### ***42. Withdrawal or Cancellation of Certificate during Repairs***

When a ship is damaged, the passenger certificate or passenger and safety certificate need be withdrawn only where the efficiency or seaworthiness of the ship is affected. If the damage is of a minor character and the Surveyor does not consider repairs to be necessary before the ship again sails with passengers, the certificate is not to be withdrawn and must not be endorsed (see the next paragraph). In other cases the Surveyor is to withdraw the certificate of the ship and the duplicates during the time she is undergoing damage repairs and report to headquarters. Should the damage be such that, in the Surveyor's judgment, the certificates should be cancelled, he should forward them to headquarters with his report. If the master or owner declines to give up the certificates the Surveyor is to inform headquarters immediately so that, if necessary, they may be cancelled.

#### ***43. Endorsement of Certificate or Issue of New Certificate after Repairs***

When the damage has been repaired and the ship rendered efficient and seaworthy to the satisfaction of the Surveyor, he should, if the passenger certificate or passenger and safety certificate has been temporarily withdrawn, endorse the certificate and duplicates to the effect that the damage has been made good so as to last for the remainder of the period for which the certificate was issued and return them to the master. The Surveyor should send to the Ministry a statement of the extent of the repairs that were necessary and a copy of the endorsement made on the certificate. Where there has been hull damage, a suitable note is to be made on form B.H.1.

A fresh survey must be carried out (and a new declaration issued) if another certificate is required for a ship that has had its certificate cancelled as a result of major damage.

When a ship has been damaged and repairs have been effected either abroad or in the United Kingdom before the Surveyor has been informed, he is to make such examination as is possible. If he is satisfied that the ship is again efficient and seaworthy in all respects, and if the damage was such that he would have withdrawn the certificate had he been able to inspect the damage before the repair, he is to endorse the certificate. A copy of the endorsement should be forwarded to headquarters, with the Surveyor's report on the damage and repairs effected.

#### ***44. Fitting of Additional Machinery, Boilers, etc., during currency of Certificate***

Surveyors should make it generally known to owners, superintending engineers and marine superintendents, that, if important pieces of machinery, etc., intended for use in connection with the propulsion of a ship, or likely to



affect her safety, are fitted on board while a passenger certificate or a passenger and safety certificate is in force, the certificate is liable to cancellation unless such items have been surveyed and passed by a Surveyor. Surveyors should also recommend an early application for survey in order that the additional machinery, etc., may be inspected during construction, so as to avoid, as far as possible, delay to the ship and inconvenience to the owners.

The Surveyors witnessing the construction of the additional machinery, etc., should each grant an incomplete declaration for the parts for which they are responsible and forward it to the Surveyor at the port at which the machinery, etc., is to be fitted on board. When the additional machinery, etc., has been fitted on board to the Surveyor's satisfaction, he should make a completing declaration, attach all the incomplete declarations concerning the construction, and send the declarations, with the relevant papers, to headquarters.

In cases where the fitting on board of the additional machinery, etc., coincides with the survey of the ship for the issue of a passenger certificate or a passenger and safety certificate, the declaration in respect of the machinery, etc., will form part of the complete declaration.

#### **45. *Cancellation of Certificates***

If there is reason to believe that, since the making of the last declaration of survey for a ship, any alteration has been made, or the hull, equipments or machinery have sustained damage or are otherwise insufficient, the ship must be again surveyed to such extent as is necessary and, in default, any passenger certificate or passenger and safety certificate issued in respect of the ship may be cancelled by the Ministry (see also paragraphs 41 to 43).

Similar action may be taken if the declaration of survey on which any such certificate was issued has been in any particular way made fraudulently or erroneously, or if the certificate has been issued on false or erroneous information.

#### **46. *Surrender of Expired or Cancelled Certificates***

The Minister may require a passenger certificate or a passenger and safety certificate which has expired or been cancelled to be surrendered as he directs. Whenever a Surveyor is instructed to obtain from an owner or master a certificate which has expired or has been cancelled, he is to apply for it immediately, and if the certificate is not surrendered without delay, he is at once to report the case to headquarters. Any owner or master who neglects or refuses to deliver up such a certificate when required to do so by the Minister renders himself liable to a fine not exceeding ten pounds.

## ***Chapter 4***

### **SHIPS NOT REGISTERED IN THE UNITED KINGDOM**

#### **47. *Production of Certificates to Customs Officers***

The master of every Safety Convention passenger ship not registered in the United Kingdom must produce to the officer of Customs from whom clearance is demanded for an international voyage from a port in the United Kingdom, an accepted Safety Convention Certificate (see the next paragraph) together with a certificate recognised by the Minister showing the number of passengers the ship is fit to carry (see paragraph 49).

#### **48. *Accepted Convention Certificates***

To be accepted, Safety Convention certificates of passenger ships not registered in the United Kingdom, must comply with the Merchant Shipping (Accepted Safety Convention Certificates) Regulations 1952 (Statutory Instruments 1952 No. 1954). Under Regulation 3, such certificates must be in the form of the appropriate model given in the Schedules to the Regulations (i.e. the same as those in Appendix IV for U.K.-registered passenger ships), and under Regulation 4 the certificate must be, by its terms, applicable to the voyage for which clearance is demanded and to the trade in which the ship is for the time being engaged. Regulations 5 and 6 show how and for how long these certificates should be issued, the requirements being the same as those for certificates for passenger ships registered in the United Kingdom.

With ships holding general safety certificates, no question will usually arise whether the certificate applies to the intended trade or voyage of the ship. If, however, it comes to the notice of a Surveyor that a short voyage safety certificate or a qualified safety certificate and an exemption certificate is in force for a ship not registered in the United Kingdom, he should take such steps as are practicable to satisfy himself that the intended voyage of the ship falls within the definition of a short international voyage, or that any conditions and limitations stated on the exemption certificate are complied with.

#### **49. *Passenger Number Certificates***

(a) *Safety Convention Countries with agreements:* For passenger ships registered in Safety Convention countries which have agreements with the United Kingdom for the reciprocal recognition of certificates showing the number of passengers the ship is fit to carry, such certificates, when accompanied by accepted Safety Convention certificates, will be recognised by Surveyors as evidence that the necessary survey requirements have been complied with (see paragraph 57).

(b) *Safety Convention Countries with no agreements:* Any passenger ship registered in a Safety Convention country which has no reciprocal agreement with the United Kingdom for the recognition of passenger number certificates, but for which an accepted Safety Convention certificate is produced, will not be required to be surveyed under the Merchant Shipping Acts except for the purpose of determining the number of passengers she is fit to carry (see also Part VIII of these Instructions). On receipt of the declaration of survey, a certificate will be issued in respect of the ship showing only the number of passengers which she is fit to carry as required by Section 274(b) of the Merchant Shipping Act, 1894 and this certificate will have effect as a passenger certificate. There will not be many cases of this kind and the arrival of any such ship should be reported to headquarters when instructions on the procedure to be followed will be given. Such reports should state, among other details, whether the ship holds an accepted Safety Convention certificate and whether any official certificate stating the number of passengers allowed to be carried is on board.

#### **50. *General Control of Convention Ships not Registered in the United Kingdom***

A Surveyor has all the powers of a Ministry of Transport Inspector under the Merchant Shipping Acts for the purpose of verifying—

(a) that there is in force in respect of a Safety Convention passenger ship not registered in the United Kingdom an accepted Safety Convention certificate ;

(b) that the condition of the hull, equipments and machinery of any such ship corresponds substantially with the particulars shown on the certificate;



- (c) that the number, grades and qualifications of radio officers or operators on board correspond with those shown on the certificate except where such certificate states that the ship is wholly exempt from the provisions of the Safety Convention relating to radiotelegraphy and radiotelephony;
- (d) that any conditions on which an exemption certificate is issued are complied with.

As a general rule it will not be necessary for the Surveyor to survey any ship not registered in the United Kingdom which possesses valid certificates issued in accordance with the terms of the Convention. Such a survey should normally only be made if he has reason to believe, as a result of a complaint or otherwise, that the conditions described on the certificates are no longer being fulfilled. Any case in which the Surveyor thinks it desirable to take any action beyond the scrutiny of the ship's certificates should be referred to headquarters for instructions before any action is taken.

#### **51. *Detention—Notification to Consuls***

Passenger ships not registered in the United Kingdom should be detained only with the authority of headquarters. In the event of detention being authorised or the control exercised under the previous paragraph giving rise to other intervention of any kind, the Surveyor concerned must forthwith inform, in writing, the Consul of the country in which the ship is registered of all the circumstances in which detention or other intervention was deemed necessary.

#### **52. *Emigrant Ships***

If a passenger ship not registered in the United Kingdom is an emigrant ship within the meaning of Section 268, as amended, of the Merchant Shipping Act, 1894, the Surveyor is to be guided by the Department's separate volume of Instructions relating to Emigrant Ships.

#### **53. *Modification of an Accepted Convention Certificate***

Where there is attached to an accepted Convention certificate, a memorandum which has been issued under the authority of the country in which the ship is registered and which for the purpose of any particular voyage modifies the certificate in respect of life-saving appliances and the number of persons on board, the certificate will have effect accordingly.

#### **54. *Issue of Convention Certificates on behalf of another Government***

The Minister may, at the request of the government of a Convention country, issue to a passenger ship registered in that country, any general safety certificate or qualified safety certificate and exemption certificate which may be issued for a passenger ship registered in the United Kingdom. Any such certificate containing a statement that it has been so issued will have effect as if it had been issued by the said Government and not by the Minister. In all such cases Surveyors will be instructed to survey the ship and to issue a declaration of survey in the manner laid down for the survey of a British ship requiring a safety certificate.

#### **55. *Ships not carrying acceptable Certificates***

Any passenger ship not registered in the United Kingdom which is not provided with a certificate or certificates which can be accepted under these instructions, is subject to the same survey as is applied to passenger ships registered in the United Kingdom. Unless such ships have been previously surveyed by the Ministry's Surveyors for the issue of a passenger certificate or certifying letter or certificate of survey, they should in general be treated in the

same way as British ships coming under survey for a passenger and safety certificate for the first time. All such cases should be reported to headquarters for instructions.

#### **56. *The 1948 Safety Convention Countries***

At the time these instructions were printed the following countries had accepted the 1948 Safety Convention or had had the Convention extended to them under Article XIII of the Convention.

Argentina	Monaco
Belgium	Netherlands
Brazil	New Zealand
Bulgaria	Nicaragua
Cambodia	Norway
Canada	Pakistan
Chile	Panama
Cuba	The Philippines
Czechoslovakia	Poland
Denmark	Portugal
Dominican Republic	Portuguese Overseas Provinces
Egypt	Republic of Ireland
Federal Republic of Germany	Roumania
Finland	Spain
France	Sweden
Greece	Switzerland
Hayti	Turkey
Hungary	Union of South Africa
Iceland	United Kingdom
India	United States of America
Israel	U.S.S.R.
Italy	Venezuela
Japan	Viet-Nam
Liberia	Yugoslavia
<hr/>	
Hong Kong	Puerto Rico
Singapore	Italian Somaliland
Alaska	Spanish Morocco
Federation of Malaya	Spanish Guinea
Hawaii	Spanish West Africa
Netherlands Antilles	Morocco
Tunisia	Overseas France

#### **57. *Recognition of Passenger Number Certificates***

Passenger Number Certificates issued by the following countries are recognised by the United Kingdom.

Australia	Netherlands
Belgium	New Zealand
Burma	Norway
Canada	Pakistan
Denmark	Portugal
Federal Republic of Germany	Republic of Ireland
Finland	Singapore
France	Spain
Hong Kong	Sweden
India	U.S.A.
Italy	U.S.S.R.
Japan	

## Chapter 5

### MISCELLANEOUS

#### 58. *Survey of Passenger Ships built Abroad*

The Ministry will not normally allow a Surveyor to go abroad beyond near Continental ports to survey a passenger ship in course of construction. When a ship which has been built abroad is presented for survey for the first time in the United Kingdom, instructions should be sought from headquarters.

#### 59. *Other Surveys Abroad*

A whole or partial survey abroad of a passenger ship for which a passenger and safety certificate is already in force will be undertaken by the Ministry only in very exceptional circumstances. At least four clear days notice before the Surveyor is required to leave must be given, and in every case the application for survey must specify in full the circumstances which, in the opinion of the applicants, render it necessary that the survey should be made outside the United Kingdom.

If it is decided that the circumstances justify the survey being carried out, the Ministry will state the conditions. The travelling expenses and additional fees chargeable in such cases are laid down in the "List of Fees and Expenses payable in connection with Marine Surveys and other Mercantile Marine Services". (See paragraph 8).

#### 60. *Alteration of Passenger Spaces*

When the passenger accommodation of a ship is increased while a passenger certificate or passenger and safety certificate is in force, and the owners wish to have the increased number of passengers inserted in the certificate before the next survey, the ship is to be remeasured, form Surveys 8A checked where appropriate, and a fresh declaration issued. If the increase in the number of passengers is approved, the existing certificate will be cancelled and a new certificate issued. An increase in the number of passengers will, however, be subject to any limitation imposed by subdivision, stability and life-saving appliances.

If the passenger accommodation is decreased while a passenger certificate or passenger and safety certificate is in force, the fact must be reported to Headquarters, and the certificate withdrawn. If the owners wish the ship still to carry passengers, she must be again remeasured, a fresh declaration granted, and a new certificate issued.

The appropriate fee is to be charged when a new certificate is issued in these circumstances.

#### 61. *Certificates of Survey or Certificates of Examination of Plans and Designs*

The Ministry's Surveyors may undertake, at owners' or builders' request, the survey or partial survey during construction of ships which for some reason will not qualify for passenger or passenger and safety certificates, and a Certificate of Survey will then be issued by headquarters. Similarly, the Ministry will examine and advise upon any plans showing the hull, scantlings, watertight sub-division, machinery and boilers and other arrangements and details proposed for the ship, and will, where the final proposals comply with the Ministry's requirements for passenger ships, issue a Certificate of Examination of Plans and Designs and stamp the plans with the approval stamp of the Department. This applies to ships which are to be built for British or foreign owners either in the United Kingdom or abroad. The procedure to be followed is given in Appendix V.



## **62. Survey for Issue of Certificates of Inspection and Tests**

Instructions about surveys for the issue of certificates covering special tests of material, survey of any part of a ship's machinery, boilers, fittings and equipments, and testing machines, are given in Appendix V. These certificates will be issued from headquarters.

Particulars of fees to be charged for the services outlined in this and the preceding paragraph are given in the "List of Fees" booklet (see paragraph 8).

## **63. Certificated Officers for Sea-going Ships**

Every British foreign-going ship, and every British home-trade passenger ship, when going to sea from any place in the United Kingdom, must be provided with officers duly certificated according to the following scale:

- (a) In every case, with a duly certificated master.
- (b) If the ship is of one hundred tons burden or upwards, with at least one officer besides the master holding a certificate not lower than that of—
  - (i) mate in the case of a home-trade passenger ship;
  - (ii) second mate in the case of a foreign-going sailing ship of not more than two hundred tons burden; and
  - (iii) only mate in the case of any other foreign-going ship;
- (c) If the ship is a foreign-going ship and carries more than one mate, with at least the first and second mate duly certificated;
- (d) If the ship is a foreign-going ship of one hundred nominal horse-power or upwards, with at least two engineers, one of which must be a first-class and the other a first-class or second-class engineer duly certificated;
- (e) If the ship is a foreign-going ship of less than one hundred nominal horse-power or a sea-going home-trade passenger ship, with at least one engineer who is a first-class or second-class engineer duly certificated.

An officer is not deemed to be duly certificated unless he is the holder for the time being of a valid certificate of a grade appropriate to his station in the ship, or of a higher grade.

It is important to note that under the terms of the Aliens Restriction (Amendment) Act, 1919, no alien may act as master, chief officer or chief engineer of a ship registered in the United Kingdom except in the case of a ship employed habitually on voyages between ports outside the United Kingdom.

## **64. Grades of Officers' Certificates**

A certificate of competency for a foreign-going ship is deemed to be of a higher grade than the corresponding certificate for a home-trade passenger ship, and entitles the holder to go to sea in the corresponding grade in the last-mentioned ship. An officer holding a foreign-going certificate of competency of any grade is eligible to act as mate of a home-trade passenger ship, but a certificate for a home-trade passenger ship does not entitle the holder to go to sea as a master or mate of a foreign-going ship.

## **65. Persons in Charge of Ships of Classes IV, V, VI and VI(A)**

It is considered necessary that at least two persons should be employed in ships of Classes IV, V, VI and VI(A). The person in charge of the ship should be one who has had sea experience and understands how to handle the ship in a seamanlike manner, and the engineer, whether he is the person in charge or not, should be experienced in his work and able to demonstrate to the Surveyor that he is competent to take charge of an engine.

## PART II

# Hull and Watertight Subdivision

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### Chapter 1

#### GENERAL

##### 66. General

New passenger ships must comply fully with the Rules. Existing passenger ships need comply with the Rules only to the extent that is reasonable and practicable in the circumstances.

##### 67. Plans and Particulars Required

In order that it may be determined whether the proposals relating to the construction of the ship comply with the requirements of the Rules, the Surveyor should obtain from the shipbuilders all plans and particulars necessary for the consideration of the case and submit them to headquarters.

##### (a) Plans and Particulars to be submitted to the Chief Ship Surveyor

The plans and particulars to be submitted to the Chief Ship Surveyor include those specified below and such other information as may be necessary for the full consideration of the builder's proposals for compliance with the Ministry's requirements for the issue of a passenger and safety certificate.

##### (1) Hull Structural Plans

- (a) A copy of the midship section and other structural plans showing the principal hull scantlings, framing, pillars and girders, and compensation in way of openings in the shell plating and strength decks.
- (b) Plans showing details and connections of the principal hull castings (or of fabricated structures fitted in lieu of such castings) and of the rudder and stabilizing fins (if fitted).

##### (2) Subdivision Arrangements and Calculations

- (a) Outline profile and plans showing the margin line (corrected as necessary); all watertight transverse and longitudinal bulkheads, decks, inner skins, shaft and other tunnels, trunks and ventilators; recesses and steps in the watertight bulkheads; double bottoms; the principal openings in the watertight bulkheads and decks and openings therein closed only by portable plates; the appropriation of spaces below the bulkhead deck; the positions of equivalent plane bulkheads; the lengths of the main transverse compartments and the watertight arrangements at the forward end.

Tunnels, recesses and steps are to be shown in plan and elevation and typical sections of the double bottom should be given.

- (b) Subdivision co-efficients and particulars on Forms B.H.1, B.H.1A, B.H.2 and B.H.2A. The particulars required to enable the Ministry to determine whether a detailed calculation of permeability is required under paragraphs 3(b)(i)(b) and 8(b) of the Second Schedule to the Construction Rules are to be submitted at once in any case where the surveyor considers these paragraphs should apply.

Calculations of equivalent plane bulkheads; allowances for local subdivision and, if available, a copy of the builders flooding calculations and curves. (See also paragraph 105(3)).

### (3) Subdivision Structural Details

Plans showing the scantlings and details of construction of oil fuel storage tanks, settling tanks and other tanks, forming part of the structure of the ship. The pressure heads upon which the scantlings are based should be indicated on the plans.

### (4) Other Structural Arrangements Below and Above the Bulkhead Deck

(a) Plans showing the arrangements, types and details of all side scuttles below the margin line and of side scuttles and windows above the margin line.

(b) Plans showing the arrangement and details of all side doors below and above the margin line.

(c) Plans showing the arrangement and particulars of ships side discharges including sewage systems, ash shoots, rubbish shoots, etc.

(d) Plans showing the means of escape from all accommodation, service and working spaces for complying with the requirements of Rule 85 of the Construction Rules and paragraph 405 of Part VII of these Instructions.

(e) In ships of Classes II, IIA, III and IV, profile and deck plans showing the means for closing openings in the weather deck, and the means for clearing such deck of water, for complying with the requirements of Rule 17 of the Construction Rules. Similar plans or sketches should also be submitted for all decked vessels of Classes V, VI and VIA.

In the case of ships of Class I, such plans need not be submitted provided the Surveyor is satisfied with the arrangements proposed, and there are no unusual features for which he requires a decision from the Chief Ship Surveyor.

### (5) Fire Protection Arrangements

Plans and particulars showing the arrangements for complying with Part V or VA of the Construction Rules and Part V of these Instructions, including the method to be used; the arrangement and details of "A" and "B" class divisions and stairway enclosures; the means of closure of openings in such divisions and enclosures; details of the fire protection to control stations; details of the fire protection to lifts and trunks for light and air.

(The arrangement and details of watertight doors, sprinkler systems and automatic fire detection and alarm systems should be submitted to the Engineer Surveyor-in-Chief—see sub-paragraph (b) below and paragraph 164(4) of Part V of these Instructions).

A copy of the plan required under Rule 43 should be forwarded with the surveyor's final report.

### (6) Stability

(a) Calculations of the stability and angle of heel in the damaged condition for compliance with the requirements of Rule 8 and the Third Schedule of the Construction Rules and paragraph 104 of Part II of these Instructions.



(b) Report of Inclining Experiment and the stability information required in accordance with Paragraph 120 of Part II and Notice M.375 and paragraph 456 of Part VIII of these Instructions.

(c) Amount and disposition of permanent ballast, if any.

*(b) Plans and Particulars to be submitted to the Engineer Surveyor-in-Chief*

(1) Particulars of the service for which the ship is intended.

(2) *Watertight doors*

(i) Plans showing the following:

the position of the bulkhead deck; the position of the deepest subdivision load line; the positions of all watertight doors, including those in longitudinal watertight bulkheads, if any; the allocation of spaces served by the watertight doors; the openings in watertight bulkheads for trunkways for refrigeration, ventilation and forced draught systems; the leads of the shafting for the hand gear or the pipes for the hand hydraulic gear of sliding watertight doors.

(ii) When power operated watertight doors are to be fitted, plans and particulars of the following:

the sources of power for operating the doors, indicators and warning signals; the arrangements for transmitting the power from the central control station for operating the doors; the gauges or indicators at the central control station for showing whether the power is available for operating the doors; the arrangements at the central control station for indicating whether the doors are open or closed; the warning signals required when the power for closing the doors is about to be applied.

(iii) Detailed plans showing:

the designs of the doors; the mechanism for operating the doors by hand and by power (if fitted); the indicators at the hand operating positions above the bulkhead deck for showing whether the doors are open or closed; the screens for preventing coal from interfering with the closing of bunker doors.

*(c) Importance of Approval of Plans, etc., before Construction begins*

Work on the construction of the ship should not be put in hand until the various plans and particulars have been approved, as inconvenience and delay may arise if alterations to the proposals are considered necessary.

As the construction of the ship proceeds, the Surveyor should ensure that the arrangements and details are in accordance with the approved plans and particulars. If the arrangements differ materially, or are in any respect unsatisfactory, the Surveyor should forward a report to headquarters together with any necessary amending plans.

## *Chapter 2*

### QUALITY AND TESTS OF MATERIALS

#### *68. Wrought Iron and Mild Steel*

Owing to the uniform character and quality of wrought iron and mild steel plates and sections used in the United Kingdom in the construction of the hulls and structures forming part of the watertight subdivision of ships, Surveyors need not witness the tests of such material before it is used.

In the case of a classed ship the Surveyor may satisfy himself that these materials have been tested by the Surveyors of the Classification Society. If the

ship is unclassed he should report the makers of the materials and see that the materials have been tested in accordance with the B.S.I. Standard Specification; for this purpose the certificates of the steel makers or of the Surveyors of a Classification Society may be accepted.

When steel of special quality is intended for use in the construction of the hull, the Surveyor should submit particulars to the Chief Ship Surveyor, who will decide what tests, if any, are necessary.

When the main structure of any ship is intended to be wholly or partially electrically welded, the Surveyor should report accordingly, when the structural plans are submitted, to the Chief Ship Surveyor, who will decide what further information and tests, if any, of the steel plates and sections are necessary.

Surveyors should examine the materials being worked into ships' hulls etc., and observe their behaviour under the various processes to which they are subjected, such as machining, punching, shearing, bending, riveting, welding, etc. Any cases where plates, bars, forgings, etc., fail while being worked, or where they appear to be of inferior quality, should be noted and the facts reported to the Chief Ship Surveyor.

When fittings which affect the safety of the ship or watertight subdivision arrangements are to be fabricated by electric arc welding processes from steel castings and steel plates and sections, the Surveyor should report the proposed chemical composition of the castings to the Chief Ship Surveyor before any work is commenced. Similar action should be taken if steel castings are to be electrically welded to the hull of the ship.

**STEEL CASTINGS AND FORGINGS FOR IMPORTANT PARTS OF THE HULL  
(CAST STEEL STEMS, CAST OR FORGED STEEL STERN POSTS, RUDDER  
FRAMES, PROPELLER SHAFT BRACKETS, ETC).**

#### **69. *Surveyor to Witness Tests***

The Surveyor should inform the builders and owners, or their representatives, that the Ministry's Surveyors should always be notified when an important steel casting or forging is to be ordered for the hull, etc., of a passenger ship, and also that, when the order is given, the steel-makers should be requested to communicate with the Surveyors, so that they can make arrangements to witness the tests. The tests should be carried out on testing machines of which the details have been approved by the Engineer Surveyor-in-Chief and of which the accuracy has been verified by the Surveyors within the preceding twelve months.

#### **70. *Process of Manufacture***

The steel for castings and forgings may be made by any process which has been accepted by the Ministry.

The forgings should be made from sound ingots, not more than the lower two-thirds of the ingot being used. The sectional area of the body of the forging should not exceed one-fifth of the sectional area of the original ingot, and no part of the forging should have more than two-thirds of the sectional area of the ingot.

#### **71. *Selection, Treatment and Stamping of Test Pieces***

All the test pieces required should be selected by the Surveyor and the tests should be made in the place of manufacture before the despatch of the casting or forging.

Test pieces should not be cut off castings or forgings until they have been stamped by the Surveyor after the annealing has been completed. The marks stamped on the test pieces of the castings and forgings should be such that the charge or ingot from which they are made can be readily identified.

If any casting or forging is subsequently annealed or otherwise heat-treated for any purpose, the test pieces should be similarly and simultaneously treated with the casting or forging before the tests are made. The test pieces should not be further treated.

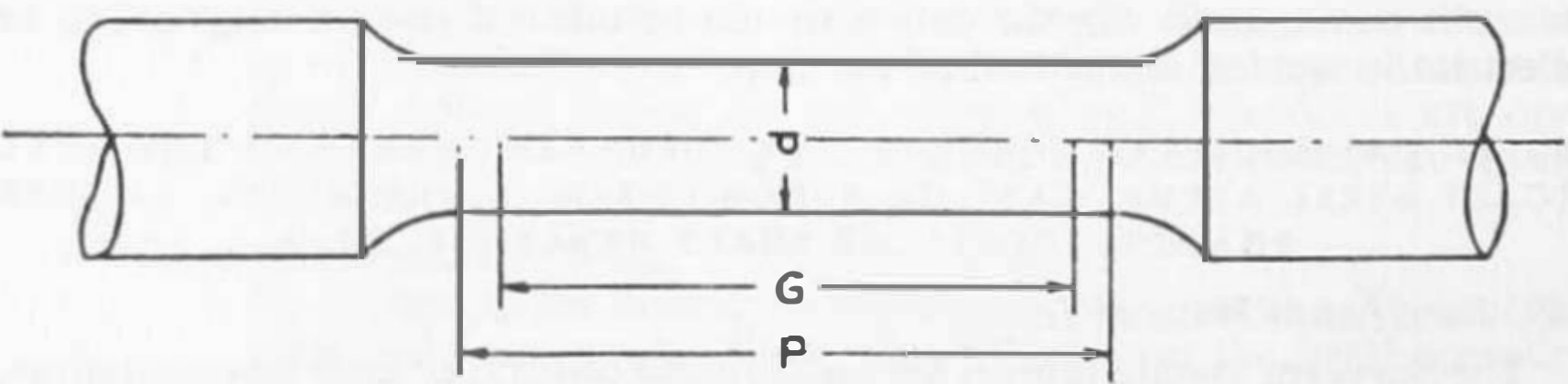
In the case of a forging, the test pieces should be taken from a part of the forging of sectional dimensions not less than those of the body of the forging and they should be machined to size without further forging down.

When a number of small castings are made from the same charge of steel, or a number of small forgings from the same ingot, the full number of tests specified need not be made ; tensile and bending tests at the rate of one of each type of test for every four castings or forgings will as a rule be sufficient.

72. (1) *Standard Test Pieces*

The forms and dimensions of test pieces should be as follows:

TENSILE TEST PIECES C, D AND E



Test Piece	Diameter d	Cross Sectional Area A	Gauge Length G	Parallel Length P (minimum)
C	in. 0.564	sq. in. 0.25	in. 2.0	in. 2.25
D	0.798	0.50	3.0	3.375
E	0.977	0.75	3.5	4.00

The gauge length and the parallel portion of the test pieces should be as shown. The form of the ends should be as required in order to suit the various methods employed for gripping the test piece.

Any reduction of the specimens to the form required should be effected by machining.

(2) *Bending Test Pieces*

The bending tests should be made with rectangular test pieces, 1 inch wide by 1/4 inch thick, which should be machined to size and have the corners rounded to a radius of 1/8 inch: they should be bent over their thinner section, either in a press or by blows.



**73. Tests for Steel Castings**

*(1) Number and Nature of Tests*

At least one tensile and one cold bending test should be made from the castings from each charge, and where a casting is made from more than one charge at least four tensile and four bending tests should be made from pieces cast as far apart as possible on the casting and as near the top and bottom as practicable.

When more than one casting is made from one charge, at least one tensile and one bending test should be made from the castings run from one common pouring head, but separate tests should be made from each casting or set of castings run from each separate pouring head.

*(2) Tensile and Bending Tests*

The tensile strength should in general range between 26 and 35 tons per square inch with an elongation measured on the standard test piece of not less than 20 per cent. The bending test piece should withstand being bent, without fracture, through an angle of not less than 120°.

If, however, there are no special features in the design of the castings, and the scantlings are sufficient, the tensile strength may range from 26 to 40 tons per square inch with an elongation of not less than 15 per cent., the bending test angle being not less than 60° when the tensile strength lies between 35 and 40 tons per square inch, and not less than 90° in other cases.

The internal radius of the bend should in no case exceed 1 inch.

**74. Tests for Steel Forgings**

*(1) Number and Nature of Tests*

At least one tensile and one bending test should be taken from each forging; but, if the weight exceeds three tons, a tensile and a bending test should be taken from each end.

*(2) Tensile Tests*

The tensile strength of steel forgings should not exceed 40 tons per square inch, and the elongation, measured on the appropriate standard test piece C, D or E, referred to in paragraph 72(1), should not be less than 17 per cent. for 40 ton steel. In no case may the sum of the tensile strength and the corresponding elongation be less than 57.

*(3) Bending Tests*

The bending test pieces should withstand being bent, without fracture, through an angle of 180°, the internal radius of the bend being not greater than that specified below:

Maximum specified tensile strength of forging	Internal radius of test piece after bending
Up to 32 tons per square inch . . . . .	½"
Above 32 tons and up to 36 tons per square inch .	1"
Above 36 tons and up to 40 tons per square inch .	1½"

**75. Annealing and Final Examination of Castings and Forgings**

All important steel castings and forgings should be thoroughly annealed at a uniform temperature and should be allowed to cool down before being removed from the annealing furnace.

If a casting or forging is subsequently reheated for any purpose it should be similarly annealed if so required by the Surveyor.

The Surveyor should examine each casting or forging and satisfy himself that it is sound and free from all flaws and defects. Hammerdressing, patching or burning is not to be permitted. In certain circumstances electric arc welding may be permitted but full details should be submitted to the Chief Ship Surveyor for his prior approval.

**STEEL CASTINGS OTHER THAN THOSE REFERRED TO IN PARAGRAPHS 69 TO 75 (WHEN FITTED IN SUCH POSITIONS THAT THE FAILURE OF THE CASTINGS MIGHT AFFECT THE SAFETY OF THE SHIP)**

**76. *Side Scuttle Frames, Deadlights and Plugs***

When side scuttle frames, deadlights and plugs of cast steel are intended for positions above the margin line they need not be tested unless the Surveyor has reason to doubt the quality and strength of the material.

When intended for positions below the margin line, however, the following tests should be made:

One frame, deadlight or plug out of every 50, and at least one of each for every ship so fitted, is to be selected at random and, before being machined, tested to destruction by being bent when cold, either in a press or by blows.

The frames and deadlights should withstand being bent, without fracture, through an angle of  $20^{\circ}$  and plugs through an angle of  $40^{\circ}$ . In the case, however, of deadlights intended for positions of sill below the higher of the following lines:

(a) 3 feet above the deepest subdivision load line;

(b) 6 inches above the deepest (seasonal) load line as determined by the load line certificate,

the deadlights should withstand being bent, without fracture, through an angle of  $30^{\circ}$ .

If the Surveyor is of opinion that, owing to the unusual depth of projecting rims, or for any other reason, the above test for frames and deadlights cannot be fairly applied, an alternative method of testing may be submitted to the Chief Ship Surveyor for approval.

**77. *Other Fittings (Elbows and Valves Attached to the Shell Plating ; Shoots for Ashes, Galley Refuse, etc., Chests for Ventilators, and other Castings of a Similar Character)***

Surveyors should satisfy themselves by witnessing cold bending tests from the castings from each charge that the material is sufficiently ductile for the intended purpose.

Tests should be made in the following proportions;

(1) one in twelve for small castings, such as elbows, valves, chests for ventilators, etc., (2) one in four for galley refuse shoots, and (3) one for each large casting, such as ash shoots.

**MALLEABLE CAST IRON**

**78. *Conditions for Use***

The use of malleable cast iron is to be sanctioned only in the special cases and under the particular conditions given in paragraphs 79 to 81. In no case should the surfaces of malleable iron castings be removed by machining, etc., to a greater extent than is absolutely necessary.

Malleable iron castings should comply with B.S. 310 Black Heart Malleable Iron Castings, grade 2 or 3, or B.S. 309 White Heart Malleable Iron Castings, grade 2.

#### **79. *Side Scuttle Frames, Deadlights and Plugs***

When side scuttle frames, deadlights and plugs of malleable cast iron are intended for positions above the margin line they need not be tested unless the Surveyor has reason to doubt the quality and strength of the material.

In no case may side scuttle frames, deadlights or plugs of malleable cast iron be accepted for positions of sill below the higher of the following lines:

- (a) 3 feet above the deepest subdivision load line ;
- (b) 6 inches above the deepest (seasonal) load line as determined by the load line certificate.

When side scuttle frames, deadlights and plugs of malleable cast iron are intended for other positions below the margin line the following tests should be made:

One frame, deadlight or plug out of every 25, and at least one of each for every ship so fitted, is to be selected at random and, before being machined, tested to destruction by being bent when cold, either in a press or by blows.

The frames should withstand being bent, without fracture, through an angle of 20°, and deadlights and plugs through an angle of 40°.

The internal radius of the bend should in no case exceed one inch.

If the Surveyor is of opinion that, owing to the unusual depth of projecting rims, or for any other reason, the above test for frames and deadlights cannot be fairly applied, an alternative method of testing may be submitted to the Chief Ship Surveyor for approval.

In addition to the above tests, each casting must satisfactorily withstand being dropped on an iron slab from a height of 10 feet for frames and 15 feet for deadlights and plugs.

#### **80. *Other Fittings (Elbows and Valves Attached to the Shell Plating ; Shoots for Ashes, Galley Refuse, etc., Chests for Ventilators, and other Castings of a Similar Character)***

In the event of proposals being received by the Surveyor to make these fittings of malleable cast iron of such special quality as to approach closely cast steel in strength and ductility, full particulars of the tensile and bending tests to which it is proposed to subject the material should be submitted to the Chief Ship Surveyor for consideration before the castings are made.

#### **81. *Rail Stanchions***

Rail stanchions of malleable cast iron may be accepted only for ships of Classes IV and V, and then only if the stanchions are capable of withstanding the following test:

One stanchion out of every 25, and at least one for each ship so fitted, should be selected by the Surveyor at random and tested to destruction by bending. Stanchions should not be passed unless they are capable of being bent while cold so that the deflection at the middle of a length of 36 inches is at least 6 inches.

### **NAVAL BRASS AND GUNMETAL CASTINGS**

#### **82. *Conditions for Use***

Naval brass and gunmetal castings, if used for side scuttles and similar fittings attached to the shell plating, must have not less than 14 tons per square inch ultimate tensile stress and not less than 10 per cent. elongation on a gauge length of 2 inches.



### **83. Side Scuttle Frames, Glass Holders and Deadlights**

When side scuttle frames, glass holders and deadlights of cast naval brass or gunmetal are intended for positions of sill below the higher of the following lines:

- (a) 3 feet above the deepest subdivision load line;
- (b) 6 inches above the deepest (seasonal) load line as determined by the load line certificate,

at least one tensile test and one bending test shall be made from each 50 castings or from the castings from each charge, whichever is the less.

The test pieces should be cast on the frames, glass holders or deadlights.

The bending test piece should be  $\frac{1}{4}$  inch in diameter and should be capable of being bent through  $60^\circ$  over an internal radius of 2 inches without showing signs of fracture.

When side scuttle frames, glass holders and deadlights of cast naval brass or gunmetal are intended for other positions of sill below the margin line or for positions above the margin line, no tests will, as a rule, be necessary unless the Surveyor has reasons to doubt the quality and strength of the material.

## **NAVAL BRASS FORGINGS**

### **84. Conditions for Use**

Naval brass forgings, if used for parts of side scuttles and similar fittings attached to the shell plating, must have not less than 25 tons per square inch ultimate tensile stress and not less than 15 per cent. elongation on a gauge length of 2 inches.

### **85. Side Scuttle Swing Bolts and Pins**

When side scuttle swing bolts and pins of naval brass forgings are intended for positions of sill below the higher of the following lines:

- (a) 3 feet above the deepest subdivision load line;
- (b) 6 inches above the deepest (seasonal) load line as determined by the load line certificate,

tensile test pieces should be cut from the bar lengths from which the parts are manufactured or, in the case of bolts, machined from the bolt. Test pieces should be chosen at random from the material from which each one hundred pins are manufactured and one test sample should be chosen from each 50 bolts.

When side scuttle swing bolts and pins of naval brass forgings are intended for other positions below the margin line, or for positions above the margin line, they need not be tested unless the Surveyor has reason to doubt the quality and strength of the material.

## **ALUMINIUM ALLOY**

### **86. Plates and Sections**

When plates and sections of aluminium alloy are intended to be used in the construction of the hull, the Surveyor should submit full particulars, including the chemical composition of the alloy, to the Chief Ship Surveyor, who will decide what tests, if any, are necessary.

### **87. Castings**

If it is intended to use Aluminium Alloy castings for side scuttles or any other fittings affecting the safety of the ship, or the watertight subdivision arrangements, or the safety of persons on board, e.g., rails and stanchions, the Surveyor should submit particulars, including the chemical composition of the alloy, to the Chief Ship Surveyor who will decide what tests, if any, are necessary.

## GENERAL

### **88. *Unsatisfactory Tests***

Should any tensile test piece break at a point outside the middle half of its gauge length, another test may be made from the same casting or forging at the makers' option and with the Surveyor's approval.

Although the material may withstand the tests laid down the Surveyor should, if the material appears to be of doubtful quality, require a greater number of tests to be made than is specified so that he may be fully satisfied about the quality of the material.

The number of tests specified for castings and forgings are those required when the material proves satisfactory. If a test gives unsatisfactory results, the Surveyor may allow another two tests to be made from the same charge or batch of material, and, if these are satisfactory, the results of the tests may be considered acceptable if the material is otherwise sound. If either of the two additional tests fails, the castings or forgings are to be rejected.

### **89. *Castings and Forgings made Abroad***

The Ministry cannot send Surveyors abroad to test castings and forgings intended for ships being built in the United Kingdom, nor can they accept certificates of quality for such castings and forgings issued by any Classification Society. Such castings and forgings must be imported with the requisite pieces attached to them so that the required tests can be made by the Ministry's Surveyors.

### **90. *Stamping Castings and Forgings***

The Surveyor should stamp, for identification purposes, all castings and forgings which have been satisfactorily tested.

### **91. *Submission of Results***

Tests of ordinary hull castings and forgings need not be submitted to headquarters, but may be dealt with locally. The Senior Ship Surveyor is to sign the relevant Form Surveys 24.

In the case of tests of material to which special conditions apply, material manufactured abroad, and any material about which there is any doubt, the results should be sent on Form Surveys 24 to the Chief Ship Surveyor.

## *Chapter 3*

### INSTRUCTIONS RELATING TO THE RULES

#### **92. *General***

Where the requirements of the Rules are clear and need no comment or explanation, no reference to those Rules will be found in these instructions. Where the instructions explain or comment upon a Rule Surveyors should be guided by both the Rule and the instructions.

#### **93. *Strength of the Hull (Rule 3)***

The structural plans and particulars specified in paragraph 67 and any other particulars which may be necessary for the purpose, should be submitted so that the Chief Ship Surveyor may determine whether the structural strength of the hull of the ship will be sufficient for the service intended.

#### **94. Survey of Hull before painting, etc.**

The survey of a ship during construction is for the purpose of enabling the Surveyor to form an opinion of the material, construction and workmanship, and the Surveyor should not undertake the survey of a new ship after the hull is painted, cemented or otherwise coated, until he has reported full particulars of the case to the Chief Ship Surveyor and received instructions about the action to be taken.

#### **95. Dry Docking**

If the outside of the hull and fittings of a new passenger ship have been surveyed and passed before the ship is launched, they need not be again examined in dry dock after launching unless the Surveyor has reason to do so. In either case a suitable record is to be made in the dry-docking book.

#### **96. Definitions—Watertight Subdivision. (Rule 1(2))**

The following notes are for the guidance of Surveyors in the interpretation of the definitions of subdivision terms given in Rule 1(2):

##### **(1) Machinery space**

In the case of unusual arrangements, the Ministry will be prepared to advise shipowners and shipbuilders of the limits of the machinery space to be taken up for the purposes of the Rules.

##### **(2) Margin Line**

(a) For a ship which has a continuous bulkhead deck, the margin line should be taken as a line drawn parallel to, and three inches below, the upper surface of the bulkhead deck at side \*

(b) If the bulkhead deck of a ship is not continuous, either the provisions of paragraph 6(1)(d) of the Second Schedule to the Rules should be applied or a continuous margin line should be assumed which at no point is less than three inches below the upper surface of the deck at side\* to which the bulkheads concerned and the shell plating are carried watertight, special consideration being given to the requirements of the Rules where reference is made to the margin line.

Where a portion of an assumed margin line is appreciably below the deck to which bulkheads are carried, the Ministry may permit a limited relaxation in the watertightness of those portions of the bulkheads which are above the margin line and immediately under the higher deck.

Examples of the procedure to be followed in such cases are illustrated in Appendix II.

(c) Surveyors should note that, as indicated in paragraph 1(3) of Part I of the Second Schedule to the Rules the expression "passenger space" includes galleys, laundries and other similar spaces provided for the service of passengers, in addition to space provided for the use of passengers, but excludes baggage, store, provision and mail rooms.

#### **97. Floodable Length. (Definitions, Rule 1(2))**

To enable the permissible length of compartments to be determined in accordance with paragraph 2 of the Second Schedule to the Rules, it will be necessary to develop flooding curves which will indicate the floodable length at any point in the ship. Flooding curves should be developed by a method of

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\* Where there is a variation in the thickness of the bulkhead deck at side, the upper surface of the deck should be taken at the least thickness of the deck at side above the beam. If desired, however, the upper surface of the deck may be taken at the mean thickness of the deck at side above the beam as calculated for the whole length of the deck, provided that the thickness is no greater than the least thickness plus two inches.



calculation which takes account of the form, draught and other characteristics of the ship. The method described in Appendix 11 should normally be used. If, however, the ship is of such unusual form that this method is not sufficiently accurate the Ministry may permit the use of an alternative method of calculation.

**98. Permeability.** (Paragraphs 3, 8 and 11 of the Second Schedule to the Rules)

For ships of Classes I, II and II(A), the assumed average permeabilities of portions of the ship before and abaft the machinery space will in general be determined by the appropriate formula given in paragraph 3(b)(i)(a) or paragraph 8(a) of the Second Schedule to the Rules. The use of detailed calculations for this purpose will be required only for ships having unusual arrangements where the average permeabilities of such portions are greater than those given by the formula. Where the Surveyor is of opinion that a detailed calculation will be required, he should *at once* submit the watertight subdivision plans and particulars of the ship to the Chief Ship Surveyor without checking the builders' calculations in order that the builders may be informed of the decision *without delay*.

The Ministry will be prepared to consider applications for the use of a detailed calculation in any case where it can be shewn that the average permeabilities so obtained are less than those given by the formula.

In cases coming under paragraph 8 of the Second Schedule to the Rules, the Surveyor should ascertain and report the type, disposition, weight and stowage rate of the cargo which the owner intends to be carried by the ship in normal service conditions.

**99. Factor of Subdivision.** (Paragraphs 4, 9 and 12 of the Second Schedule to the Rules)

(1) If, in the case of any ship of Class II or Class II(A) whose factor of subdivision falls to be dealt with under paragraph 9(2)(c) of the Second Schedule to the Rules, the Ministry is satisfied that it is impracticable to comply with a unity factor of subdivision in particular compartments, such exemptions as appear justified in the circumstances will be allowed in respect of those compartments. So far as the aftermost compartment and the forward compartments between the forepeak and the after end of the machinery space are concerned, exemptions will only be granted in exceptional circumstances.

Where plans are forwarded for a ship to which this sub-paragraph applies and a unity standard of subdivision is not attained throughout, the plans should be accompanied by a statement of the reasons why, having regard to the intended service of the ship, it is considered by the owners or shipbuilders impracticable to apply the unity factor of subdivision to a particular compartment or compartments.

(2) If, in the case of any ships of Classes III and IV whose factor of subdivision falls to be dealt with under paragraph 12 of the Second Schedule to the Rules, the Ministry is satisfied that it is impracticable to comply throughout the ship with the required factor of subdivision, exemption may be allowed subject to such conditions as appear reasonable in the circumstances.

**100. Criterion of Service.** (Paragraphs 5 and 9(2)(b) of the Second Schedule to the Rules)

For ships not having a continuous bulkhead deck, the volumes used for the purpose of calculating the Criterion Numeral should be taken up to the actual margin lines used in determining the floodable length.

**101. Allowance for Local Subdivision.** (Paragraph 6(7) of the Second Schedule to the Rules)

Any claim for an allowance for local subdivision under the provisions of paragraph 6(7) of the Second Schedule to the Rules should be accompanied by

plans showing the proposed local subdivision and the volume of the main and sub-compartment concerned. No allowance should be made where these compartments are liable to be in open communication below the margin line through air, sounding or other pipes, or otherwise. The Surveyor should satisfy himself on completion of the ship that this condition has been properly observed.

#### **102. *Shaft Tunnels.* (Rule 6(3))**

The watertight shaft tunnel, or other watertight space, in which under Rule 6(3) the stern gland is to be situated, should be of sufficient height and width to allow proper attention to be given to shaft couplings, bearings, etc., within the space.

#### **103. *Double Bottoms.* (Rule 7)**

The inner bottom may only be pierced for such manholes as are necessary for access, which must be fitted with efficient covers. The joint between the cover and the bottom must be effectively watertight. All air and sounding pipes are to be effectively protected against risk of damage from cargo, coal, etc.

If wells for purposes other than drainage are proposed and the Surveyor considers they are essential they should be as small as possible and full particulars of the method to be adopted for maintaining the protection given by the double bottom should be submitted to the Chief Ship Surveyor for consideration.

#### **104. *Stability in Damaged Condition.* (Rule 8 and the Third Schedule to the Rules)**

Calculations of angle of heel and of the stability in the damaged condition should be submitted to the Chief Ship Surveyor. The stability conditions assumed in these calculations are to be confirmed after the ship has been inclined (see paragraph 120).

If cross-flooding fittings are proposed to deal with a condition of unsymmetrical flooding, full details of such fittings and calculations showing that they will expeditiously reduce the list to an angle not exceeding 7° should be submitted to the Chief Ship Surveyor.

In this connection, the Surveyor's attention is drawn to the need for air pipes of adequate area in relation to the area of the cross-flooding fittings. Information about these cross-flooding fittings and other information about stability in the damaged condition is to be provided to the master (see paragraph 120)

Paragraph 2 of the Third Schedule lays down the final condition to be achieved by the ship after sustaining damage to the extent specified in paragraph 1 of that Schedule. Exemption from this requirement will not normally be granted. In an exceptional case, the Ministry may consider whether conditions less favourable than those specified in (i) and (ii) of paragraph 2 of the Third Schedule can be accepted, provided it is shown to the satisfaction of the Ministry that no alteration of the design is practicable or reasonable. Surveyors should impress upon builders that particulars of any such exceptional case should be sent to the Ministry at the earliest possible stage. In any case, if a negative metacentric height is accepted in the event of symmetrical flooding the resulting heel must not be more than 7° and in the event of unsymmetrical flooding the heel must not exceed 15°.

The Surveyor should satisfy himself that the stability data required by Rule 8(4) is incorporated in the stability data available on board to the master of the ship.

#### **105. *Verification of Subdivision Particulars***

(1) The coefficients and particulars on Forms B.H.1, B.H.1A, B.H.2, B.H.2A, referred to in paragraph 67(a)(2), are required for developing flooding curves, and the Surveyor should, therefore, ensure that the information given on these



forms is correct. In order that the proposed subdivision of the ship may be considered quickly, the Surveyor may, in cases of urgency, forward the coefficients and particulars without first checking the builder's calculations upon which they are based, but in such cases the Surveyor should proceed with the checking concurrently with the consideration of the plans at headquarters. If, in the process of checking, any material errors are found in the builders' calculations, the Surveyor should immediately advise the Chief Ship Surveyor and send the correct particulars. In any event, particulars of the unusual cases referred to in paragraph 98 should be submitted at once.

(2) Except as provided in sub-paragraph (3), the builders of the ship are not obliged to furnish a copy of their calculations, but the Surveyor should check these at the shipyard and take such notes of the figures as will enable him to identify them at any future date. If the builders make flooding calculations by the method set out in Appendix II, and are willing to furnish a copy of them, these calculations should be forwarded to facilitate the work at headquarters. The builders of the ship should be informed that, in the event of any alteration being made in the lines plan after the coefficients, etc., have been verified, the calculations should at once be revised, re-checked by the Surveyor and the results forwarded to the Chief Ship Surveyor so that the flooding curves may be amended as necessary.

(3) If a ship is of such unusual form that special subdivision calculations and curves are made as provided for in paragraph 97, these should be checked at the shipyard and a complete copy forwarded for consideration.

#### **106. Construction of Watertight Bulkheads, etc. (Rule 9 and the Fourth Schedule to the Rules)**

(1) *Riveted Construction.* Watertight bulkheads and other portions of the internal structure forming part of the watertight subdivision of the ship, when of riveted construction, must comply with the requirements of Rule 9 and the Fourth Schedule to the Rules. Surveyors should note that the scantlings of the rolled sections given in the Tables in Part IV of the Fourth Schedule are based on the British Standard specifications named in the footnotes to the Tables.

With regard to paragraph 3(3) of the Fourth Schedule to the Rules, Surveyors should note that, in general, the distance between the lines of support for the beams should not exceed 15 feet.

Certain small vessels of Classes IV to VI may be exempted by the Minister from such requirements of paragraph 10(2) of the Fourth Schedule to the Rules as are unreasonable in the circumstances.

##### **(2) Welded Construction**

(a) Where it is proposed to use welding in the construction of watertight bulkheads, etc., the plans and particulars supplied should include details of the proposed method of welding. Only electric arc welding processes are recognised for this purpose by the Ministry and, when these processes are used, the electrodes should be of types accepted by the Ministry for use in parts of ships of primary structural importance. The welding should be of the highest standard and efficiently arranged. The workmanship must be to the satisfaction of the Surveyor, special attention being paid to scalloped stiffeners and to the avoidance of scallops in way of the end connections of the stiffeners.

(b) Paragraph 1(2) of the Fourth Schedule to the Rules requires that bulkheads, etc., of welded construction must be of at least the same strength, stiffness and efficiency as that required for bulkheads, etc., of riveted construction and, to comply with these requirements, the scantlings of stiffeners on bulkheads, etc., of all-welded construction and of riveted



stiffeners with all-welded brackets may, subject to the approval of headquarters, be derived as follows:

- (i) Calculate the modulus  $\left(\frac{I}{y}\right)$  and the moment of inertia (I) of the riveted stiffeners by the appropriate Table in Part IV of the Fourth Schedule to the Rules in conjunction with 24 inches  $\times$  40 inches of plating in the case of angle bar stiffeners, and 24 inches  $\times$  60 inches of plating in the case of bulb angle and channel bar stiffeners.
- (ii) Reduce the calculated values of  $\left(\frac{I}{y}\right)$  and (I) referred to in (i) by the amounts given in the following table:

Description of Stiffener	Table of Part IV of Fourth Schedule	Maximum percentage reduction of moduli $\left(\frac{I}{y}\right)$ and moments of Inertia (I) allowed	
<b>BRACKETED ENDS*</b>			
All sections, excluding flats, with all-welded brackets	Table 2	$\frac{I}{y}$	15%
		I	25%
Flats with all-welded brackets	"	$\frac{I}{y}$	5%
		I	15%
Riveted stiffeners with closely spaced end rivets and all-welded brackets	"	$\frac{I}{y}$	10%
		I	15%
<b>LUOGED ENDS</b>			
Stiffeners with efficiently welded ends in lieu of lugs or with all-welded lugs	Table 3	$\frac{I}{y}$	5%
		I	15%
Stiffeners with all-welded lugs of same section extended to adjacent floor or frame	"	$\frac{I}{y}$	10%
		I	15%
<b>EXTENDED ENDS</b>			
Stiffeners with efficiently welded ends continued by stiffeners of approximately similar sections in 'tween decks above, in 'tween decks or double bottom below, welded at end or ends	Table 3	$\frac{I}{y}$	10%
		I	15%
<b>UNATTACHED ENDS</b>			
Stiffeners without end connections	Table 3	$\frac{I}{y}$	nil
		I	15%
<b>CONTINUOUS STIFFENERS</b>			
Continuous stiffeners			
(a) where extreme ends are bracketed and where intermediate points of support are firm;	Table 2	$\frac{I}{y}$	nil
		I	15%
(b) where extreme ends are lugged	Tables 2 and 3	$\frac{I}{y}$	nil
		I	15%

\* Brackets not extended to the adjacent floor or frame should be treated as equivalent to lugs.

- (iii) The moduli  $\left(\frac{I}{y}\right)$  and moments of inertia (I) of the welded stiffeners calculated in conjunction with the same amount and thickness of plating as assumed in (i) should each not be less than the  $\left(\frac{I}{y}\right)$  and (I) values obtained after reducing the calculated value in (i) by the appropriate percentages given in (ii) above.
- (iv) Similar percentage reductions to those given in (ii) may be made to the moduli  $\left(\frac{I}{y}\right)$  and moments of inertia (I) of the scantlings specified for riveted tunnel stiffeners in Table 5 in Part IV of the Fourth Schedule to the Rules, having regard to the type of end connections.
- (v) No reductions should be permitted in the moduli  $\left(\frac{I}{y}\right)$  of the scantlings of riveted stiffeners specified in Tables 2A, 3A, 3B and 5A of the Fourth Schedule to the Rules, but the moments of inertia of such scantlings may be reduced up to a maximum of 15%.

#### 107. *Initial Tests of Bulkheads, etc.*

##### (1) *Hose Tests*

- (a) Testing main compartments by filling them with water is not compulsory. A complete examination of the bulkheads should, however, be made by the Surveyor and, in addition, a hose test should be made in all cases.
- (b) A hose or flooding test should be applied to watertight decks and a hose test to watertight trunks, ventilators and tunnels.
- (c) Hose testing of watertight bulkheads, including the watertight doors and the attachments of the door frames to the bulkheads, decks and tunnels, should be simultaneously inspected on both sides of the plating while the water is being played upon all riveted, welded and caulked surfaces.
- (d) The pressure of the water in the hose should not be less than 30 lb. per square inch.

##### (2) *Pressure Tests*

- (a) The forepeak, double bottoms, duct keels and inner skins should be subjected to a head of water up to the margin line.
- (b) Tanks which are intended to hold liquids and which form part of the subdivision of the ship should be tested for tightness with water to a head to the deepest subdivision load line or to a head corresponding to two-thirds of the depth from the keel to the margin line in way of the tanks, whichever is the greater, provided that in no case should the test head be less than 3 feet above the top of the tank. These tests are for the purpose of ensuring that the subdivision structural arrangements are watertight, and should not be regarded as a test of the fitness of any compartment for the storage of oil fuel or for other special purposes for which a test of a superior character may be required, depending on the height to which the liquid has access in the tank or its connections (see Part VI paragraph 359).

(3) Except as provided in sub-paragraph (4), the hose and pressure tests should be carried out in the presence of, and to the satisfaction of, the Surveyor, and he should record the results of the tests in form B.H.1.

(4) If a ship under construction is not intended to carry oil fuel in the double bottoms, the Surveyor need not necessarily witness the tests of these compartments unless the ship is not classed. If, however, the double bottoms are to be used for oil fuel the Surveyor should witness the tests whether the ship is classed or not.

#### 108. *Openings in Watertight Bulkheads.* (Rules 10 and 11)

Rule 10 sets out the conditions under which openings are permitted in watertight bulkheads and other structures forming part of the watertight subdivision of the ship.

Regarding the requirement of Rule 10(3) that a watertight door must be fitted at one end of a tunnel, Surveyors should note that an exemption from this requirement can be considered for short tunnels situated near the centre line of the ship, if the safety of the ship in the event of damage is not impaired.

In other cases, in lieu of piercing the bulkhead at this end of the tunnel for a watertight door access may be obtained by means of a trunkway extending watertight to above the margin line.

Under the provisions of Rule 10(6), watertight bulkheads outside the machinery space may not be pierced by openings which are capable of being closed only by portable plates. Such openings may, however, be permitted for special purposes in watertight bulkheads within the machinery space.

In view of the nature of the services in which ships of Classes III to VI are engaged, Rule 10(7) lays down that watertight bulkheads in such ships are not to be pierced by doorways, ventilation trunks or similar openings. In exceptional cases, however, such openings may be permitted for special purposes provided that full particulars of the openings and the means of closing them are submitted to the Ministry for consideration and approval.

Rule 11 lays down the types of watertight doors to be fitted to openings in watertight bulkheads. Any doors to be fitted to openings on longitudinal watertight bulkheads are to be submitted for special consideration by the Ministry.

#### 109. *Means of Operating Watertight Doors.* (Rule 12)

(1) The general requirements for the means of closing watertight doors are set out in Rule 12.

(2) *Sources of power.* Rule 12(6) requires the provision of at least two sources of power for opening and closing power operated sliding watertight doors. If the sources of power are electrical, the provisions of Rules 35 and 36 apply, but where the operating system is electro-hydraulic, two sources of hydraulic power will be required, viz., two pumps or their equivalent, in addition to the main and emergency sources of power required by Rules 35 and 36.

(3) *Hand operating gear.* (Rule 12(7) and (8)). The mechanism for operating sliding watertight doors by hand from above the bulkhead deck should be rapid in its action and sufficiently powerful so as to be capable of operating the doors under unfavourable conditions. The operating gear above the bulkhead deck and, in the case of non-power operated doors, at the door itself should consist of a crank handle or wheel and handle for all-round operation which should, in general, be permanently attached to the shafting. It is desirable that the hand gear of power operated doors fitted at the door itself should be of a similar type, but other types can be considered if the local gear is such that it could not interfere with the operation of the door from above the bulkhead deck. The lead of shafting to the door from above the bulkhead deck should be as direct as possible. Suitable provision should be made for lubricating the working parts of the mechanism, and guards should be fitted where necessary. Alternatively, a suitable hand operated fluid transmission system for operating these doors



from above the bulkhead deck will be considered. The hand operating gear of power operated doors should be permanently engaged unless satisfactory means are provided for engaging it from above the bulkhead deck.

(4) *Watertight doors serving as fireproof doors.* (Rule 12(9)). In machinery spaces where there is a fire hazard such as with internal combustion machinery or oil fired boilers, watertight doors should be capable of being operated from outside the space in which the fire hazard is present. This may be arranged as indicated in the Rule by placing the hand operating gear which is above the bulkhead deck outside the machinery space, or by fitting the hand operating gear which is at the door itself to the side of the bulkhead remote from the fire hazard. Alternatively, the desired object, i.e. access for fire fighting, may be achieved by fitting a draught-excluding firescreen door to the bulkhead, capable of being closed from outside the space.

#### **110. Watertight Doors—Signals and Communications.** (Rule 13)

The indicators and warning signals required by Rule 13(1) and (2) should, if electrically operated, obtain their power from the main and emergency sources provided in accordance with Rules 35 and 36.

The sound signal which, under Rule 13(2), is required to give warning at the door itself when power operated watertight doors are about to be closed, should precede the movement of the doors by an interval of about 10 seconds.

#### **111. Construction of Watertight Doors.** (Rule 14)

Rule 14(1) requires every watertight door to be of such design, material and construction as will maintain the integrity of the watertight bulkhead in which it is fitted. For this purpose it may be necessary, particularly with large sliding watertight doors, to arrange points of support in way of the leading and trailing edges of the doors at the closed position.

In the case of sliding watertight doors, steps should be taken to ensure a satisfactory connection where the door frame beds on to the bulkhead plating and, in compartments where oil fuel may catch fire, these connections should be metal to metal. If jointing is used it should be of asbestos material. For other watertight doors, e.g. in 'tween decks, the use of a thin hard wood packing may be permitted if the wood is fire-proofed and the Surveyor is otherwise satisfied. For doors in places where the danger of fire is remote, ordinary thin hard wood will probably suffice.

#### **112. Tests of Watertight Doors**

(1) Every watertight door should be tested at the works in the presence of the Surveyor by hydraulic pressure equivalent to the head of water measured from the bottom of the door to the margin line in way of the bulkhead to which the door is to be fitted, but in no case should the test pressure be less than 20 feet head for sliding doors or less than 10 feet head for hinged doors. The framework to which the door frame is secured for the purpose of testing at the works should not give greater reinforcement to the frame than the stiffening of the bulkheads to which it is to be fitted. The purpose of the test is to show whether the door is of sufficient strength and reasonably watertight under pressure. The rate of leakage, if any, should be reported.

After satisfactory hydraulic test, each watertight door and its frame should be stamped with the following identification marks:

M.  T.  
TESTED TO      FEET HEAD  
DATE  
SURVEYOR'S INITIALS

(2) After being fitted in place on the bulkhead in the ship, the door and the attachment of the door frame to the bulkhead should be included in the hose test required for watertight bulkheads. (See paragraph 107).

(3) All sliding watertight doors should be operated by hand and, if power operated, by power in the presence of the Surveyor, who should report the times taken to close the doors. In the case of bunker doors, the closing tests should be made when coal is in the bunkers to ensure that they comply with the requirements of Rule 14(8).

(4) The Surveyor should see that the warning signals are efficient and comply with the provisions of paragraph 110 and that the indicators register properly.

(5) Hinged watertight doors are to be inspected and tried. The Surveyor should see that the lever operated clips are in order and that the joints are watertight.

### 113. *Openings in the Shell Plating below the Margin Line.* (Rule 15)

(1) The general requirements for openings in the shell plating below the margin line and their means of closing are set out in Rule 15.

(2) (a) British Standard Specification B.S. 3024 dated 1947 (and addenda) forms a useful guide for side scuttle makers and shipbuilders about the types of side scuttles which, subject to their satisfactory general design, would be accepted by the Ministry for ships of Classes I, II and II(A). Side scuttles up to a maximum diameter of 12" are acceptable for the position defined in Tables 1 and 2 and up to 16" for the positions defined in Tables 3 and 4 of the British Standard Specification. Where, in ships of Class I, side scuttles are fitted in positions defined in Tables 1 and 2, of that Specification, the main frame securing bolts should be screwed through the shell plating, but clearance bolts or rivets may be used for side scuttles fitted in other positions.

(b) In the case of ships of Classes III to VI, such modifications of the requirements of the British Standard Specification as appear reasonable may be allowed having regard to the intended service of the ship.

(3) Rule 15(4) requires that all side scuttles fitted below the margin line in ships of Classes III to VI should be of the non-opening type. In exceptional cases, however, side scuttles of the opening type may be allowed in certain positions if the plans are accompanied by a statement from the owners or shipbuilders giving the reason why it is considered necessary to fit such side scuttles in those positions.

(4) Surveyors should note that while under the proviso of Rule 15(5) deadlights may for the purposes of the Construction Rules be portable in certain crew spaces and passenger spaces not appropriated for the use of steerage passengers, such deadlights must be permanently attached in their proper positions if so required by the Load Line Rules. Any other special rules for side scuttles which are laid down in the Load Line Rules must also be complied with in passenger ships. Portable deadlights should always be stowed convenient to the side scuttles they serve.

(5) Discharge pipes fitted in accordance with the provisions of Rule 15(8)(f) should have a sufficient bend to provide for expansion of the pipe and any movement due to the working of the ship.

(6) When water closets of the under-waterline type are to be fitted, plans should be specially submitted for approval.

(7) Rule 15(8)(j) requires that every ash shoot, rubbish shoot, etc., should have a watertight cover and, if the inboard opening is below the margin line, be fitted in the shoot with an automatic non-return valve. When the shoot is not in use, both the cover and the valve should be kept closed and secured, and a permanent notice to this effect should be fixed near the hopper.

(8) Subject to the requirements of sub-paragraph (9), secondary means of closing scuppers and discharges from enclosed superstructures on the freeboard deck are required except:

- (a) in ships where openings in the freeboard deck have satisfactory means of closing and the freeboard is not less than .06 of the maximum moulded breadth of the ship; and
- (b) in other ships where the freeboard is not less than .13 of the maximum moulded breadth of the ship.

Where no secondary means of closing is required, the storm valve fitted at the ship's side is to be of a substantial back-balanced type or of a type in which the valve face is at an angle of not less than 15° to the vertical when closed.

In the case of ships not coming under (a) or (b) above, secondary means of closing scuppers and discharges from enclosed superstructures on the freeboard deck are required, and such means should comply with the requirements of Rule 32(a) of the Load Line Rules, 1941, for the means of closing scuppers and discharges from spaces below the freeboard deck.

(9) In all ships, the incidence of the calculations made under the provisions of the Third Schedule to the Rules relating to stability and angle of heel in the damaged condition will be taken into account by headquarters in approving the means of closing scuppers, discharges and other side openings from spaces above the margin line.

#### **114. Rules concerning Openings in Bulkheads and in Shell Plating**

(1) The statutory requirements regarding the closing of, and keeping closed, openings in watertight bulkheads and in the shell plating below the margin line are laid down in the Merchant Shipping (Closing of Openings in Hulls and in Watertight Bulkheads) Rules, 1952, (S.I.1952 No.1953), made under Section 19 of the Merchant Shipping (Safety Convention) Act, 1949.

For the side scuttles referred to in Rule 2(2)(b) of those Rules, the Chief Ship Surveyor will indicate the mean draught at which the sills of these side scuttles will not be below the line defined in that Rule and at which it will therefore be permissible, on the responsibility of the master of the ship, to depart from port without previously closing and locking them. In the application of this sub-paragraph the appropriate allowance for fresh water may be made when applicable. The Surveyor should, therefore, report to the Chief Ship Surveyor in appropriate cases such particulars as will enable the limiting mean draught to be determined. For this purpose the distance of the sill below the bulkhead deck at side should be reported of the opening type side scuttle which has its sill the greatest distance below the bulkhead deck at side, this dimension being measured vertically at the side scuttle. It should be noted that it does not necessarily follow that the lowest side scuttle in the tier determines the position of the zone line at the limiting mean draught, unless the sills of all the opening type side scuttles are the same distance below the bulkhead deck at side all fore and aft.

The limiting mean draught resulting from the information supplied will be communicated to the Surveyor, who should pass it on to the owners and satisfy himself, in due course, that the master has been informed.

(2) The Surveyor should ensure that the responsible ship's officers have been properly instructed regarding the closing and keeping closed, during navigation, of the watertight doors, portable plates, side scuttles and deadlights, and gangway, cargo and coaling ports referred to in Rule 2(2) and 4 of the above Rules, and that an appropriate notice is posted up in the chart room.



### **115. Side and other Openings above the Margin Line. (Rule 16)**

(1) Surveyors should note that the provisions of paragraph 113(2)(a) and (b) also apply to side scuttles fitted to openings in the ship's sides above the margin line.

#### **(2) Deadlights**

(a) In ships of Classes I, II and II(A) deadlights should, subject to the requirements of the Load Line Rules, comply with the following:

(i) In enclosed superstructures situated immediately above the bulkhead deck, efficient hinged deadlights which can be effectively closed and secured watertight should be fitted to all side scuttles in all spaces, except that, in any spaces that are appropriated for the use of crew or passengers, other than steerage passengers, side scuttles may have portable deadlights if the deadlights are stowed convenient to the side scuttles.

(ii) In other enclosed superstructures, side scuttles and windows should either be provided with deadlights which may be portable, or be designed to receive outer plugs or shutters. Such portable deadlights, plugs and shutters should be provided to the extent of 50 per cent. of the total number of side scuttles and windows not fitted with efficient hinged deadlights, or such lower percentage as may be warranted by the positions and designs of the side scuttles and windows.

(b) The above requirements will apply to ships of Classes III to VI, subject to such modifications as appear reasonable having regard to the intended service of the ship.

### **116. Subdivision Load Lines. (Rule 18)**

(1) Under Rule 18, ships of Classes I and II having spaces which are adapted for the accommodation of passengers and the carriage of cargo alternatively may have, if the owners desire, one or more additional load lines assigned and marked corresponding to the subdivision draughts approved for the alternative conditions. The notation C1 should be used for the deepest subdivision load line, and the notations C2, C3, etc., for the alternative conditions of service.

For ships of Classes II(A) to VI, the notation C should be used when only one subdivision load line is assigned and marked on the ship. When more than one subdivision load line is assigned to the ship, the notation C<sub>A</sub> should be used for marking the deepest subdivision load line, and the notations C<sub>B</sub>, C<sub>C</sub>, etc., for the alternative conditions of service.

(2) The freeboard corresponding to each approved subdivision load line which the Surveyor is required to include in his declaration should be measured at the same position and from the same deck line as the freeboard determined by the Load Line Rules.

(3) In no case may any subdivision load line be assigned and marked on the ship's sides above the deepest load line in salt water determined by the Load Line Rules.

(4) In no case may a ship be so loaded that, when she is in salt water, the subdivision load line mark appropriate to the particular voyage and condition of service is submerged.

(5) Whatever may be the position of the subdivision load line marks, the ship must in no case be loaded so as to submerge the load line mark, appropriate to the season and locality, determined by the Load Line Rules.

(6) Before issuing his declaration, the Surveyor should inspect the subdivision load line marks on the ship's sides and satisfy himself that they comply with the

requirements of Rule 18 and the foregoing instructions, and that the positions of the marks to which the ship may load when carrying passengers correspond with the approved subdivision draughts.

#### **117. *Verification of Watertight Subdivision Arrangements***

When the watertight subdivision arrangements have been approved, the plans will be returned to the Surveyor. He should satisfy himself that the approved arrangements are provided in the ship. The procedure described below should generally be followed:

##### **(a) *Spacing of Watertight Bulkheads***

The positions of the main transverse bulkheads should be noted from the approved subdivision plans and recorded in Form B.H.1. These positions should be checked at the ship together with those of the approved steps and recesses in the watertight bulkheads and the arrangements of the longitudinal watertight and non-watertight bulkheads.

##### **(b) *Form of Ship***

In order that the Surveyor may ensure that the form of the ship as built agrees substantially with the particulars from which the flooding curves have been developed, he should adopt the following or other approved procedure:

A series of depths and breadths to the moulded lines in plane of each main transverse bulkhead, or other more convenient positions, should be measured from the approved plans and entered in Form B.H.1. In ordinary cases it will be sufficient to measure the breadths at points obtained by dividing the depth into six equal parts. The corresponding depths and breadths should be measured at the ship and entered in Form B.H.1.

##### **(c) *Appropriation of Spaces***

The appropriation of all spaces upon which the calculations of the average permeabilities and the criterion numeral are based should be entered in Forms B.H.1 and B.H.1A, and, when the ship is completed, the Surveyor should examine each space and satisfy himself that it will be used for the purpose shown on the approved plans. If it appears that a space will be used for another purpose which would involve a higher average permeability throughout the portion of the ship in which the space is situated, or an increase in the criterion numeral, the Surveyor should draw the attention of the builders to the matter and report the facts to the Chief Ship Surveyor.

##### **(d) *Survey of Watertight Subdivision Arrangements before Painting, etc.***

The provisions of paragraph 94 apply also to the first survey of watertight bulkheads, etc., and the Surveyor should take similar action if these are painted, cemented or otherwise coated before he has examined them. Particular care should be exercised by the Surveyor to satisfy himself that the integrity of the watertight subdivision where pipes, etc., pass through steps or recesses in watertight bulkheads is not impaired.

##### **(e) *Entries in Forms B.H.1 and B.H.1A***

On completion of the ship, the Surveyor should ensure that all the necessary particulars have been entered in Forms B.H.1 and B.H.1A, and forward the forms to the Chief Ship Surveyor.

#### **118. *Watertight Subdivision of Vessels of Classes IV and V***

Vessels of Class IV must always be fully decked to comply with the requirements for watertight subdivision in the Rules. Vessels of Class V may be fully decked, partially decked or open. If fully decked they must comply with the appropriate requirements for watertight subdivision in the Rules.

**119. Freeboard—Ships of Classes VI and VI(A) and open or partially decked ships of Class V**

When the vessel is loaded with weights representing the full number of passengers and crew at 140 lb. for each person, and when all the necessary fuel is on board, the clear height of side above water, at the lowest point, is not to be less than 15 inches for vessels 20 feet in length or less, and 30 inches for vessels 60 feet in length and over. For lengths between 20 and 60 feet the height should be in proportion. The length should be measured from the forward side of the stem to the after side of the stern post, and the clear side should be measured to the top of the covering board or to the top of the wash strake, if one is fitted above the covering board. If, however, a half-deck is fitted, the clear side should be measured to the top of the deck at side or to the top of the gunwale, whichever measurement gives the smaller freeboard. In decked boats the freeboard should be measured from the top of the deck at side.

The above requirement regarding minimum freeboard also applies where cargo is carried in addition to passengers.

**120. (a) Stability**

Every passenger ship must be inclined upon its completion and the elements of stability determined. The Surveyor is to witness the inclining of the ship and satisfy himself that it is carried out in such manner and under such conditions as will give reliable results. He should also take whatever steps are necessary to satisfy himself of the accuracy of the stability information derived therefrom. This is especially important in the case of ships of Classes II to VI(A) (see also the paragraphs on stability in Part VIII and Appendix VI).

**(b) Stability Data**

The owners must supply the master with stability data for the ship, and full particulars regarding this are set out in Notice No. M.375. The information regarding stability in the damaged condition required by Rule 8(4) should be included in this stability data.

**(c) Permanent Ballast**

The nature, amount and distribution of any permanent ballast is to be reported (in the form B.H.1 if appropriate).

## *Chapter 4*

### **ANNUAL SURVEYS**

**121. Duties of Surveyors**

Surveyors should satisfy themselves at the annual surveys that the hulls of passenger ships are in good condition, that the principal structural scantlings are maintained, that the arrangements and details generally are in accordance with the Ministry's requirements, and that the ship is in all respects fit for her intended service. Any proposals for altering the structure which may affect the main or local strength of the ship must be submitted to Headquarters for consideration.

**122. Examination of Hull, etc., in Dry Dock**

The Surveyor should make a thorough examination in dry dock of the outside of the hull after it has been cleaned and before it is painted, cemented or otherwise coated. The rudder and all other outside fittings and their fastenings, are also to be inspected. (See also paragraphs 7, 8 and 16 of Part I and paragraph 126 of this Part.)



### **123. *Inside of Hull***

In order to examine the interior structure properly the Surveyor should have removed such parts of the ceiling, linings, deck coverings, etc., and such tanks opened up as he considers necessary to enable him to ascertain the condition of the structure, including the riveting and welding. Particular attention should be given to the condition of the structure under the main engines, under and abreast the auxiliary machinery and boilers, and in the coal bunkers. Where cement, patent composition or tiles are fitted on steel, they should be examined and, where cracked, loose, or otherwise faulty in appearance, such portions should be removed as the Surveyor considers necessary to enable him to form an opinion of the condition of the structure.

The Surveyor may at his discretion require any of the oil fuel storage tanks of ships using oil fuel to be opened up for his inspection, but in ordinary cases, unless there are special circumstances which in his opinion necessitate more frequent inspections, it will be sufficient if one or more tanks are steamed out and examined internally at each annual survey. The tanks throughout the ship should be opened up in rotation so that each is thoroughly examined at least once in every four years and to ensure this a record should be made, in form B.H.1, of the tanks examined at each survey.

### **124. *Watertight Bulkheads, Decks, Tunnels, etc.***

The Surveyor should examine the condition of all watertight bulkheads, decks, tunnels, etc. in order to ascertain whether their watertightness has in any way been impaired. Special attention should be given to the lower portions of the bulkheads below platforms and in the bilges. The Surveyor should satisfy himself that the approved subdivision arrangements and details, including piping, valves and fittings which affect these arrangements, are maintained. For this purpose he should obtain Forms B.H.1 and B.H.1A from the Chief Ship Surveyor, and compare the arrangements and details in the ship with those recorded in the Forms. (See paragraph 25 of Part I).

Any proposals for alterations in the subdivision arrangements and details must be submitted to the Ministry. When alterations have been made, Forms B.H.1 and B.H.1A should be amended as necessary.

### **125. *Openings in Watertight Bulkheads, etc.***

All watertight doors (including the operating mechanism) and other means for closing openings in watertight bulkheads, etc., are to be inspected. Any defects must be made good.

Sliding watertight doors are to be opened and closed by hand, and also by power if the doors are power operated.

In the case of dropping doors in existing ships, the Surveyor should ensure that the gear for tripping and re-engaging the hand gear is in proper working order.

The indicators at all deck operating positions and the indicators and warning signals in connection with power operated doors should be inspected and tried.

Hinged watertight doors are to be inspected and tried. The Surveyor should ensure that the lever operated clips are in order and that the joints are watertight.

### **126. *Openings in Ships' Sides and Bottoms***

All side scuttles, valves and other fittings for preventing the accidental admission of water into the ship should be examined, either in dry dock or otherwise as most convenient, to ensure that they are effective for their intended purpose. It is important that not only should the closing appliances of scuppers, sanitary and other discharges be examined, but also discharge pipes, particularly the lower lengths, whether or not fitted with valves at the ships sides.

In ships having a large number of scuppers, sanitary and other discharges, the Surveyor need not insist upon the withdrawal of all the valves, etc., for examination at any one survey, apart from those in connection with the main and auxiliary machinery, provided that he is satisfied after the withdrawal of at least 25 per cent. of the valves, etc., that the withdrawal of the remainder is unnecessary.

A record should be made in form B.H.1 of the valves, etc., examined at each survey to ensure that every valve, etc., is withdrawn for examination at least once in every four years.

### **127. Load Line Markings**

The Surveyor should see that the subdivision load line markings are in accordance with those assigned in connection with the approved subdivision arrangements, and that the other load line markings are in accordance with the current load line certificate.

### **128. Stability Information**

The Surveyor should ensure that the information about the stability of the ship in a damaged condition, and the further information regarding intact stability (Section 18, 1949 Act) is available to the master of the ship.

The nature, amount and distribution of permanent ballast should be checked and Form B.H.1 noted accordingly.

## PART III

# Bilge Pumping Arrangements

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### 129. *General*

Part III of the Rules, and the instructions that follow, apply to all new passenger ships.

### 130. *Plans and Particulars Required*

The following plans and particulars of each new ship should be submitted to the Engineer Surveyor-in-Chief at an early stage:

- (a) Particulars of the service for which the ship is intended.
- (b) The length, breadth and depth of the ship as defined in Rule 1(2), and the length of each watertight compartment.
- (c) The number, position, type and capacity of the pumps available for bilge pumping service and the source of power for operating them.
- (d) Plans showing:
  - (i) the arrangement of watertight bulkheads and the allocation of spaces between the bulkheads;
  - (ii) the arrangements and sizes of the main and branch bilge suction pipe lines, the direct bilge suction, the flexible bilge suction hose, if any, and the arrangement of the ballast pipe lines;
  - (iii) the arrangement and type of valves at the bilge pumps and in the distribution chests of the bilge suction system, and the positions from which the bilge suction valves and the main sea inlet and direct suction valves of the main engine circulating pumps referred to in Rule 26(5) can be operated;
  - (iv) the arrangements for draining all spaces below the bulkhead deck;
  - (v) the means provided for preventing water from a damaged compartment finding its way into another compartment through a bilge suction system; and
  - (vi) the sounding arrangements.

### 131. *General. (Rule 22)*

#### (1) *Emergency Pumping*

The Rules require that provision shall be made for pumping from any watertight compartment under emergency conditions. A ship's pumps could not cope with the water which would flow into a watertight compartment laid open to the sea, but it must be possible to pump from the compartments adjoining the damaged compartment to prevent the slow flooding of the undamaged compartments by leakage through bulkheads, etc., which would endanger the ship.

#### (2) *Bilge Suctions*

Wing bilge suction is to be provided where necessary to drain compartments when the ship is listed. In narrow compartments at the ends of the ship one centre line suction may be sufficient. In compartments of unusual form, additional suction may be required.



### *(3) Bilge and pipe fittings at bulkheads*

The Surveyor's attention is directed to the following provisions of Rule 10(8) which have a bearing on bilge pumping arrangements:

- “(a) (i) Valves and cocks not forming part of a pipe system are not to be fitted in any bulkhead required by the Rules to be watertight.
- (ii) If any such bulkhead is pierced by pipes, scuppers, electric cables or other similar fittings, means are to be provided for ensuring that the watertightness of the bulkhead is not thereby impaired. In this connection valve chests, cocks, pipes and other fittings attached to subdivision watertight bulkheads or tunnel plating are to be secured by means of studs welded to or screwed through the plate, or by tap bolts, but not by bolts passing through clearance holes.”
- “(b) The collision bulkheads should not, in general, be pierced below the margin line by more than one pipe except that, if the forepeak is divided to hold two different kinds of liquids, the collision bulkhead may be pierced below the margin line by not more than two pipes. Any pipe which pierces the collision bulkhead shall be fitted with a screwdown valve which can be operated from above the bulkhead deck, the valve chest being secured to the forward side of the collision bulkhead.”

## **132. Bilge Pumps**

### *(1) Number and Type of Bilge Pumps*

Rules 23, 24 and 25 prescribe the number and type of bilge pumps which are to be provided. For the purpose of these Rules, ballast, sanitary and general service pumps may be accepted as independent power bilge pumps if they are of suitable capacity and fitted with connections to the bilge pumping system.

### *(2) Priming*

Rule 26(2) requires that every bilge pump shall be self-priming unless efficient means of priming are provided. An efficient central priming system, in duplicate, may be accepted as a means of priming, but where such a system is proposed, details should be submitted to the Engineer Surveyor-in-Chief.

### *(3) Capacity of Independent Power Bilge Pumps*

In order to comply with Rule 26(3), independent power bilge pumps must be capable of giving a speed of water through the ship's main bilge pipe of not less than 400 feet per minute. This capacity may be determined by the following formula:

$$C = 3.74 D^2$$

where  $C$  = Capacity of pump in tons per hour; and

$D$  = Internal diameter of the main bilge pipe in inches, obtained in accordance with Rule 28(1).

The required capacity of bilge pumps driven by the ship's main engines is not specified in the Rules, but where, on any ship, a main engine bilge pump is replaced by an independent power bilge pump, it is desirable that the capacity of the independent power pump should approximate to that of the other independent power bilge pumps in the ship, but some latitude may be allowed, particularly where the capacity of the other independent power pumps provided is in excess of the minimum specified.

Rule 26(3) also requires that every independent power bilge pump shall have a direct suction from the space in which it is situated and that the diameter of the suction shall not be less than that of the ship's main bilge pipe. Where, however, an independent power bilge pump is installed in a shaft tunnel and a direct suction of the required diameter is led from the pump to the engine room, the direct suction serving the tunnel space may be of a smaller diameter.

Rule 26(5) requires that main engine circulating pumps shall be fitted with direct suction connections. This requirement should be taken as being applicable to motor ships as well as to steam ships. Its application however to steam and motor ships may normally be confined to ships of Classes I, II, II(A) and III. Where objection is raised, as in the case of motor ships, to the fitting of such connections, the alternative provision in the machinery space of direct suctions on other suitable pumps of equivalent capacity may be accepted.

*(4) Suction Lift of Hand Pumps*

In order to comply with Rule 26(6), hand bilge pumps must in the case of a decked vessel be workable from above the bulkhead deck, if any. In such cases the suction lift should not exceed 16 feet when the pump is connected to the ship's main bilge pipe, or 24 feet when the pump has a single direct suction.

**133. Bilge Pipes**

*(1) Rule 27(3)*

Bilge suction pipes must not be led through double bottom tanks. In exceptional cases however, when it is considered impracticable to comply with this requirement full details should be submitted to the Engineer Surveyor-in-Chief.

*(2) Rule 27(4)*

Bilge suction pipes should generally be made with flanged joints, but other types of joint of equal efficiency will be accepted.

**134. Sounding Arrangements**

Rule 32.—The sounding arrangements should consist of sounding pipes or an efficient indicating apparatus. Sounding pipes should, when possible, be straight, but where this is not practicable, the curvature of the pipes must permit the ready passage of the sounding rod or chain.

**135. Annual Surveys**

Surveyors should examine and operate the bilge pumping arrangements at each annual survey. All power and hand bilge pumps should be tested and the direct suction connections should be tested on the bilges. Any emergency pump fitted should be tested to see that it starts quickly and that it operates satisfactorily.

## PART IV

# Electrical Equipment and Installations

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## GENERAL

Part IV of the Rules and the Instructions that follow set out the requirements with which the electrical equipment and installations of new passenger ships must comply.

### 136. *Survey of New Installations*

- (a) When surveying the electrical equipment and installations in new passenger ships, Surveyors should ensure that the arrangements, materials and scantlings comply with the Rules, and that the workmanship is in all respects satisfactory.
- (b) Generally, as indicated in Rule 34(2), generators, motors, switchboards, wiring and all parts of electrical power and lighting installations should comply with the relevant provisions of the Regulations for the Electrical Equipment of Ships 1939 and the Supplement of 1947 issued by the Institution of Electrical Engineers, except in so far as those Regulations are inconsistent with the Rules.
- (c) Generators of 100 kilowatts and over and motors of 100 horse power and over intended for services in connection with the propulsion and safety of the ship should be inspected by Surveyors during construction and testing.

Other essential electrical machines intended for the said services are to be tested by the makers as far as is practicable to ensure that the temperature rise, dielectric strength, insulation resistance and operating characteristics comply with the requirements of the I.E.E. Regulations 1939 and the Supplement of 1947. Makers' Certificates covering the tests may be accepted by Surveyors.

### 137. *Electric Lifts*

Surveyors should be satisfied that any electric lifts on passenger ships which they survey are maintained in good condition.

Owners should make arrangements for inspection and maintenance of the lifts by the lift makers or other suitable organisations. The inspections should be carried out at intervals not exceeding twelve months and certificates or reports covering these should be supplied. If such a certificate or report is produced or some equally satisfactory arrangements are made, surveyors need not insist on the opening up of working parts or the dismantling of safety devices, etc., for their inspection.

### 138. *Safeguarding Generators etc., against Flooding. (Rule 35)*

The safeguarding arrangements required by this Rule must ensure that services which are essential for the propulsion and safety of the ship will not be put out of action by a partial flooding of the ship's machinery space and shipbuilders' proposals in this connection should be submitted at an early stage.

The amount of flooding against which safeguarding arrangements should be made cannot be stated exactly, but for guidance it is considered that ample provision will have been made if such generators, etc., are so situated or



arranged that they will continue to operate until a depth of water has accumulated in the space of about one inch per foot of the breadth of the ship (assuming the ship is on even keel) or five feet whichever is the less.

### **139. Essential Services**

The electrically operated services essential to the safety of the ship and of all persons on board which are required by Rule 34(1) to be maintained under emergency conditions are those indicated in Rule 36(1)(a) to (e). If the communication equipment and signals which may be required in an emergency are electrically operated from generating sets they should also be capable of being operated by batteries. The auxiliary services essential for the propulsion or safety of the ship referred to in Rule 38(3) are the services supplied by auxiliary machinery necessary for propulsion, bilge and fire pumping, engine and boiler room ventilation, essential lighting, steering gear and communication and alarm systems. Providing there is no interference with essential services the means for disconnecting non-essential circuits may be arranged to suit the owners' convenience.

### **140. Batteries**

- (a) Batteries should be installed in accordance with Regulations 1501 to 1506 of the I.E.E. Regulations 1939 and the Supplement of 1947, special attention being given to the arrangements for ventilation (Regulation 1505) and to avoiding a position for the battery which may be subjected to extremes of temperature (Regulation 1503 as amended by the 1947 Supplement).
- (b) The voltage drop referred to in Rules 36(2) and 37(2) should not exceed  $12\frac{1}{2}$  per cent. of the nominal rated voltage and the voltage variation of the battery should be within the limits of plus 10 per cent. and minus  $12\frac{1}{2}$  per cent. from fully charged to completion of full performance of its prescribed duty at  $\frac{1}{4}$ -hour discharge rate.
- (c) When inspecting batteries, Surveyors should be satisfied that the rated capacity is sufficiently maintained to ensure performance of the required duty. Generally, if any cell fails to give 80 per cent. of the rated capacity initially required, it should be considered unfit for further service.
- (d) A certificate of inspection by a battery maker of repute may be accepted by the Surveyor with regard to the above; such certificates should be forwarded to the Engineer Surveyor-in-Chief.
- (e) Suitable provision should be made for re-charging the batteries. (See also Regulation 411 of the I.E.E. Regulations re indicators to show whether the batteries are in service).

### **141. Steering Gear Circuits**

Rule 38(4) requires cables and motors of steering gears to be protected against no lesser load than a short circuit. This should be interpreted as meaning protected against 100 per cent. overload and the overload setting of any circuit breakers in such circuits should be about 100 per cent. overcurrent as recommended in the note appended to Regulation 313(d) of the I.E.E. Regulations 1939. Similarly, the current rating of any fuses in the circuit should be such that a fuse will not operate below 100 per cent. overcurrent. It is the practice of some Companies, when batteries are installed as required by Rule 36 and the steering gear is electrically operated, to provide also for the batteries to operate the steering gear in an emergency. The gear is then one of the services automatically supplied by the batteries on failure of the main supply. The advantage of this arrangement, should a failure of main supply occur when the ship is navigating in narrow waters, is obvious, and it can be accepted provided it does not interfere with the working of essential services in emergency.

## **142. *Sprinkler Systems—Circuits and Controls***

Paragraph 2(i) of the Sixth Schedule to the Rules requires the provision of not less than two sources of power supply for pumps, air compressors and alarms of sprinkler systems, and Rule 38(5) requires such power supply, if electrical, to be taken through the emergency switchboard by a feeder reserved solely for that purpose.

It is recommended that the emergency generator should be of sufficient power and so connected as to serve the sprinkler system, in which case it can be regarded as one of the two sources of power required for that system.

It will not be necessary for the emergency generator to be capable of supplying power for the operation of the emergency services referred to in Rule 36(1), (a) and (c) and the sprinkler system simultaneously. The arrangements should however be such that the operation of these emergency services is not interfered with.

One of the advantages of having the sprinkler system connected to the emergency generator supply is that the system can be kept ready for immediate automatic operation in port should the main generators be out of action and no shore water supply be available for connecting up to the sprinkler pipes (see paragraph 27 of the Report of the Working Party on Fire Prevention and Fire Fighting in Ships in Port).

The arrangements should be such that adjustments or repairs can be effected to the compressor unit or fresh water pumping unit without interference with the power supply to the sprinkler pump unit.

The alarm circuit may if desired be supplied from the emergency batteries.

At the central fire control station there should be a light, failure of which will indicate the failure of the power supply to the alarm circuit. This light should be screened, if necessary, for the convenience of officers on watch.

## **143. *Cables***

### **(a) *Position of Main and Emergency Feeder Cables***

The object of Rule 38(6) is to ensure that main and emergency feeder cables are kept apart as far as is practicable so that a fire will not immediately affect both sets of cables.

### **(b) *Sheathing and Protection of Cables.* (Rule 39(2))**

Metal sheathed or armoured cable will not be considered necessary where the composition of the cable sheath is such that an electrical fault could not cause a fire. Cables within paint rooms, oil stores and other spaces containing highly inflammable material, should be metal sheathed, metal armoured or should be contained in screwed metal conduit.

Where a cable is in such a position that it is specially liable to mechanical damage, armoured cable should be used or the cable should be otherwise suitably protected. Any cable which is exposed to weather should be protected in accordance with Regulation 905(C) of the I.E.E. Regulations 1939 as amended by the 1947 Supplement.

## **144. *Junction and Outlet Boxes***

The junction and outlet boxes referred to in Rule 39(4) should be of metal or other material as effective as metal in preventing the spread of fire.

## **145. *Precautions with regard to Electric Lamps and Space Heaters***

### **(a) *Position of Electric Lamps.* Rule 39(5)**

The intention of this Rule is to prohibit electric lamps being so arranged that the heat radiated from them could affect the insulation of the electrical wiring or cause risk of fire by heating up any nearby material.

*(b) Electric Space Heaters. (Rule 39(6))*

So that the risk of fire from electric space heaters may be reduced to a minimum it should not be possible for clothing, curtains or other material to be scorched or catch fire however close they may come intentionally or accidentally.

**146. Spare Parts and Tools. (Rule 40)**

The following lists indicate the kind and minimum quantity of spare parts of the ship's electrical equipment and installations which should be provided on ships of Classes I, II and II(A) in order to comply with the requirements of Rule 40.

*(a) Electrical propelling Machinery*

Owing to the varied character of electrical propelling machinery it is not possible to set out a list of spare parts which will satisfy this requirement for all types of electrical propelling machinery. Surveyors should, therefore, obtain in every case, a list of the spares which it is proposed to provide and submit it to the Engineer Surveyor-in-Chief. The following typical list of spare parts for propelling machinery is given as a guide as to what might be necessary.

*(i) Generators, Motors and Exciters*

One set of bearing bushes, including oil rings if fitted, for each size of machine.

Two lines of brush holders of each size and type.

One set of carbon brushes for a generator.

One set of carbon brushes for a motor.

One set of carbon brushes for each size and type of excitation machine.

One shunt field coil of each size and kind used for D.C. machines.

One set of insulation or insulated brush studs for two lines of brushes of each size and type.

One armature for each excitation machine if no alternative means of excitation is provided.

One set of slip rings for each size of A.C. machine.

*(ii) Switch and Control gear*

One set of contacts for each size of those liable to burning or wear.

One set of springs.

Ten per cent. of each different resistance element but at least one of each size.

One of each type and size of shunt coil.

Ten per cent of each different fuse holder but at least two of each and twelve of each type of fuse cartridge or cut-out.

*(b) Essential Electrical Equipment and Installations, other than Electrical Propelling Machinery*

For electrical equipment and installations, other than electrical propelling machinery, the following spare parts, etc., should be carried for the electrical equipment and installations specified:

*(i) Generators and Motors*

One set of carbon brushes for one machine of each type and size.

*(ii) Steering Gear*

One spare armature complete with shaft and half coupling for each size fitted.

One spare field coil of each type and size.



(iii) *Control Gear*

One set of contacts of each size for those liable to burning or wear.  
One set of springs.

Ten per cent. of each different resistance element but at least one of each kind.

One of each type of shunt coil used for contactors, relays or low voltage release.

(iv) *Switch Gear and Distribution Boards*

For each type of circuit breaker on each pole—

One set of contacts of each size for those liable to burning or wear.

One set of wearing parts.

One set of springs.

One shunt trip coil and one resistance element of each kind used.

Ten per cent., but not less than twelve, of each type of cartridge or other non-renewable fusible cut-out.

Rewireable fuse holders: five per cent. with a minimum of one of each size, provided that not more than twelve need be supplied.

(v) *Navigation Lights*

One spare lamp for each lantern.

(vi) *Emergency Lighting*

If supplied from storage batteries of a different voltage from the ship's mains—

One complete set of spare lamps.

(c) *Miscellaneous*

(i) A sufficient quantity of control cable, insulating tape, and fuses or fuse wire.

(ii) One set of any special tools required for overhauling or servicing.

**147. Periodic Surveys**

The Surveyor should satisfy himself generally on the condition of the electrical installation, equipment, wiring and spare gear. Safety devices and the fittings on switchboards should be examined. It is desirable that records of insulation resistance of the various circuits should be kept by the Ships' Engineers; these records should be examined and insulation tests should be asked for if thought necessary (see also paragraph 389 of Chapter 15 of Part VI of these Instructions).

## PART V

# Fire Protection

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### 148. *Definitions.* (Rule 1(2))

The following instructions are for the guidance of Surveyors in the interpretation of the definitions of control stations and public rooms given in Rule 1(2):

- (a) *Control Stations.* The term compass in the definition includes the master gyro compass even if that compass is fitted away from the main navigating position.
- (b) *Public Rooms.* Deck spaces temporarily enclosed by side or end screens or similar fittings are not normally to be regarded as public rooms for the purposes of the Rules. If, however, such spaces usually contain combustible furniture and fittings which in the Surveyor's opinion form a substantial fire risk, he should submit full particulars to the Chief Ship Surveyor for decision as to whether such spaces are to be regarded as public rooms.

### 149. *Exemptions.* (Rule 42(1)) *See also Rules 58 and 59(1)*

(1) The ships of Classes I, II and II(A) referred to in Rule 42(1), which may be exempted from the requirements of Rules 47 to 54 and 56 to 60, are ships primarily engaged in the carriage of cargo but which carry more than 12 but not more than 36 passengers. Such ships will normally be granted the exemptions provided that, if they are Classes I and II, they are fitted with an efficient fire detection and alarm system in the accommodation and service spaces (see paragraph 164(1)) in addition to any fire detection and alarm system required by the Fire Appliances Rules to be fitted in any space which is inaccessible to a fire patrol. The Surveyor should, however, report to the Ministry the case of any such ship which carries little cargo but has extensive accommodation and service spaces.

(2) In the case of ships of Class II(A) carrying not more than 36 passengers, the Ministry will be prepared to consider applications for exemption from the requirement in Rule 42(1) that a fire detection and alarm system should be provided in the accommodation and service spaces.

### 150. *Exhibition of Plans.* (Rule 43)

Surveyors are to ensure that the plans showing the details required by Rule 43 are properly exhibited at the control station or stations where the indicators and alarms of the fire detection systems are situated.

### 151. *"A"\* and "B" Class Divisions.* (Rule 44: Quality and Tests of Materials)

"A" class divisions should normally be constructed of steel and should, in general, be of scantlings and stiffness equal to that specified in the Third Schedule to the Rules for watertight bulkheads in the 'tween decks immediately below the bulkhead deck. Applications for the use of other metals for "A" class divisions will be considered provided that they have, with appropriate insulation, integrity properties equivalent to steel at the end of the applicable fire exposure.

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\* For easy reference A60 may be used to indicate insulated steel divisions and AO to indicate non-insulated steel divisions.

Materials intended for the insulation of "A" class divisions and materials intended for use in the construction of "B" class divisions, and their method of assembly, are to be tested in the presence of a Ministry Surveyor at the Fire Testing Station of the Department of Scientific and Industrial Research and Fire Offices' Committee, Joint Fire Research Organisation, Boreham Wood, Herts. A copy of the result of the test should be sent by the applicant to the Chief Ship Surveyor. It should be noted that, although under Rule 44(2), "B" class divisions constructed of incombustible material are required to comply with the requirement relating to increase of temperature only during the first 15 minutes of the standard fire test, the test is to be continued up to the end of 30 minutes to ensure that the material is capable of preventing the passage of smoke and flame throughout the whole of that period.

Surveyors will be advised of the materials and methods of assembly which have been accepted by the Ministry for use in the construction of "A" and "B" class divisions.

It should be noted that, in addition to any fees and expenses payable to the Ministry for the Surveyor's attendance at the test applicants will also be responsible for any charge levied by the Fire Testing Station.

#### **152. *Ships' Structures.* (Rule 45)**

(1) Rule 45(1) requires that the hull, structural bulkheads, decks and deck houses of ships of Classes I, II and II(A) must be constructed of steel. Any application for permission to use other metals, e.g. aluminium alloys, should be submitted to the Chief Ship Surveyor for consideration.

(2) Under Rule 45(2) the mean length of each main vertical zone is not to exceed 131 feet but this length may be slightly exceeded in any case where it is considered impracticable to comply strictly with this Rule.

(3) Any application for exemption from the requirements of paragraphs (2) and (3) of Rule 45, should state the reason why they cannot be applied to a particular ship having regard to its design and intended service. Plans should be forwarded showing the allocation of spaces throughout the ship and the shipbuilders' proposals for providing equivalent methods of fire protection.

#### **153. *Fire-resisting Doors, etc.* (Rules 46, 48(2) and 49(1))**

(1) All fire-resisting doors and similar closing appliances fitted in accordance with Rules 46, 48(2) and 49(1) must be of types which have been accepted as complying with the Rules. It is not intended that these doors and appliances should be capable of being closed from a central control station but that the self-closing arrangements referred to in these Rules should be fitted at or on the door or appliance itself. The self-closing device should operate easily and smoothly and in such a way as not to endanger a person passing through the opening. The doors may normally be kept in the open position when the ship is on service providing they can be readily released.

(2) Dampers required by Rule 46(2) should in all cases be fitted in ventilating and similar trunks which pass through "A" class divisions including main vertical zone bulkheads, engine and boiler room casings, and boundary bulkheads of galleys, main pantries and control stations.

#### **154. *Separation of Accommodation Spaces from other Enclosed Spaces.* (Rule 47)**

In the application of Rule 47, insulation will not be required for steel decks separating accommodation spaces from other enclosed spaces except where they form steps in main vertical zone bulkheads, or where they separate accommodation spaces from galleys, control stations or spaces in which the boilers and machinery for the propulsion of the ship are situated, and associated spaces. Insulation need not normally be fitted to steel decks and bulkheads separating ventilation or air conditioning machinery, refrigerating machinery and similar spaces from accommodation spaces.



**155. *Protection of Stairways.* (Rule 48)**

To facilitate consideration of exemptions from the requirements of Rule 48(1), plans of the sprinkler system required by paragraph 165 should show the position and size of all stairways protected by the system.

**156. *Light-and-Air and Similar Trunks.* (Rules 49(1) and (3))**

The expression "similar trunk" used in Rules 49(1) and (3) is intended to apply to trunks whose construction is similar to that of light-and-air trunks. It is not intended to apply, for example, to small vertical trunks passing from one 'tween deck to another from which are led horizontal branch trunks fitted with punkah louvres or similar fittings which can be closed in the event of fire. In any case of doubt the Surveyor should submit full particulars to the Chief Ship Surveyor for consideration.

**157. *Protection of Control Stations.* (Rule 50)**

(1) In applying the requirements of Rule 50(1), Surveyors should note that the radiotelegraph room and the emergency generator must be enclosed by "A" class divisions. An exception may be made of the radiotelegraph room if it occupies an island site, i.e. if there are no compartments adjacent to it. If a control station houses the compass, direction-finder, radar equipment, steering wheel and the central fire recording equipment in two or more rooms, it may ordinarily only be necessary for the outer boundaries separating the control station from other enclosed spaces to be constructed of "A" class divisions.

(2) For the purpose of applying the provisions of Rule 50(2) it is considered that, as the radio officer is often required in an emergency to remain at his post until the latest possible moment, the radiotelegraph room should be so situated as to minimise the risk of fire reaching it by way of stairways. This room should never be situated directly above a main stairway nor directly above any subsidiary stairway if this arrangement can be avoided. An emergency means of escape from the room, preferably to the open deck, should always be provided.

**158. *Protection of Store Rooms, etc.* (Rule 51(1))**

Paint rooms, lamp rooms and similar spaces should be situated as far as practicable from accommodation and service spaces. In general, the boundary bulkheads separating baggage, mail, store, paint and lamp rooms from other spaces should be constructed of steel but need not be insulated. The heavy steel doors normally fitted to such spaces will be accepted as sufficient to maintain the integrity of the bulkheads in which they are fitted.

**159. *Deck Sheathing.* (Rule 52)**

Any composition for use as deck sheathing mentioned in Circular 1950, may be accepted as complying with the requirements of Rule 52.

**160. *Detection of Smoke in Concealed or Inaccessible Places.* (Rule 54(2))**

Small holes made in ceilings, panels and linings and protected by metal gauze, may be accepted as complying with Rule 54(2).

**161. *Window Frames in Upper Deckhouses.* Rule 54(7)**

Where Method II of fire protection is adopted, metal window frames need not be insisted upon in deckhouses situated in upper structures where they are not liable to damage from weather or sea. Details should be submitted to the Chief Ship Surveyor for consideration.

**162. *Electric Radiators***

The requirements with which electric radiators must comply are set out in Rule 39(6).

### 163. *Cinematograph Exhibitions.* (Rule 55)

(1) Rule 55 specifies that the cinematograph equipment on any passenger ship carrying inflammable film for exhibition on board must comply with the requirements of the Fourth Schedule to the Rules. The following instructions are for the guidance of Surveyors in the survey of such equipment, and they also include certain principles which should be observed by the ship's officers in charge of arrangements during cinematograph exhibitions.

#### (2) *Type of Film*

By inflammable film is meant film of the "nitro-cellulose" type as distinct from slow burning film of the "acetate-cellulose" type.

#### (3) *Submission of Plans and Particulars*

When inflammable film is to be used for exhibition on board the ship, the following plans and particulars should be submitted to the Engineer Surveyor-in-Chief at an early stage:

- (a) A general arrangement plan showing the position of the spaces in which cinematograph exhibitions are to be given, the position of the projector room or the site of the projector cabinet or portable projector, the seating arrangements in the auditorium and the exit doors.
- (b) Details of the projector room or cabinet, showing the means provided for complying with paragraphs 3(2) to (8) of the Schedule.
- (c) Details of any portable projectors, showing the means provided for complying with paragraph 6 of the Schedule. These details need not be furnished if the projector is of a type already accepted.

#### (4) *Exhibitions in Public Rooms*

Wherever practicable, there should be a fireproof operating space separate from the auditorium for housing the projectors when inflammable film is to be used and not less than two projectors should be provided to make easier the unhurried changing of films.

The auditorium should be well ventilated and provided with sufficient and alternative exits to enable the audience to leave quickly in an emergency. The marking of exits required by paragraph 1 of the Schedule should be in about 7 inch lettering. The seats should be arranged in rows with intersecting and unobstructed gangways leading to the exits. Preferably loose chairs should not be used. A space of not less than 3 feet should be reserved around any projector cabinet or portable projector to prevent the audience from coming into contact therewith.

#### (5) *Storage of Films*

With regard to paragraph 2(2) of the Schedule no objection will be raised if the projector is of a type which has metal spool boxes permanently attached to it, where the spools of film have to be taken from the metal spool box container and charged into the metal spool box on the projector, provided that the spool box has a CO<sub>2</sub> connection which is automatically released if the film ignites.

Such operations as the rewinding and repair of films and the loading of metal containers, should be carried out in the film storage room or a similar fire-resisting compartment other than the projector room or cabinet, but the operations may be carried out in the projector room or cabinet when the projectors are not being used.

#### (6) *Projector Rooms and Cabinets*

Sufficient space within the projector room or cabinet is to be provided at the sides and back of the projector to enable the operator to work freely. In projector rooms, about 2 feet 6 inches at the sides and 3 feet at the back of the projector is considered suitable.

During an exhibition, the number of metal spool box containers in the projector room or cabinet should be kept to a minimum and not more than one container should be opened at a time. All films not in process of being shown should be kept in containers.

### *(7) Portable Projectors*

Portable projectors should be mounted on a suitable stand which should preferably be secured to the deck during an exhibition. While the exhibition is in progress, the number of loaded spool boxes in the auditorium at any time, including those on the projector, should not exceed three.

### *(8) Electric Circuits, etc.*

All electric wiring and fittings of cinematograph installations should comply with the relevant requirements of Part IV of the Rules and with paragraphs 143, 144 and 145(a) of these Instructions.

### *(9) Fire Extinguishing Appliances*

An asbestos smothering blanket and an accepted type of two-gallon froth extinguisher (or two tetrachloride fire extinguishers) are to be provided in the projector room or cabinet or near the portable projector when in use. The ship's fire appliances, including the portable fire extinguishers in or near the space where exhibitions are being given will also be available for use in the event of fire, and operators and their assistants should acquaint themselves beforehand where these extinguishers are and how to use them.

### *(10) Operators and Supervision*

A competent operator should be in charge of the cinematograph apparatus and he should have a competent assistant in attendance to supply and remove films and to assist him generally during the exhibition. The operator should not leave the apparatus during the whole of the exhibition and no unauthorised person should be allowed to use the apparatus or enter the projector room or cabinet.

All arrangements for cinematograph exhibitions on board passenger ships should be under the direct supervision of one of the ship's officers whose duty it should be to see that the exits from the auditorium are unobstructed, that the exit doors are free to open outwards, that the precautions outlined in the foregoing paragraphs and in the Fourth Schedule to the Rules in regard to the storage and handling of films are observed, and that the fire appliances specified are available for immediate use while exhibitions are in progress.

## **164. Automatic Fire Alarm and Detection Systems. (Rules 42(1) and 58(1))**

(1) For the purposes of the fire alarm and detection systems required by Rule 42(1) to be fitted in ships carrying 36 passengers or less the accommodation and service spaces may be divided into groups. A group should be confined to one deck and should not be split by a main vertical zone bulkhead or a watertight bulkhead. At least one detector head should be fitted in each cabin or other small space but more than one detector head may be required in large spaces. All the detector heads in a group must be connected to an indicator for that group, and to an audible alarm common to all groups, at each central control station.

(2) For the purposes of the fire alarm and detection systems required by Rule 58(1) the provisions of sub-paragraph (1) apply and in addition:

- (a) In ships in which the Method I of fire protection is adopted the spaces on the starboard side should be grouped separately from those on the port side. No group should extend more than 65 feet over the length of the ship.
- (b) In ships in which the Method III of fire protection is adopted each public room should generally be treated as comprising one group. Other accommodation and service spaces should be grouped so that the spaces within each compartment formed by the network of "A" and "B" class divisions referred to in Rule 57(2)(a) form one group. So far as is practicable no group should include more than fifteen cabins.



### (3) *General*

Automatic fire alarm and detection systems should be so constructed as to give an indication at the central control station of any failure of the power supply to the system.

There should be not less than two sources of power, each capable of operating the system. If the system is electrically operated, the detail of the electric system must conform with the requirements of Part IV of the Rules. Power for operating the system should be available at all times while the ship is in service.

Means must be provided by push button or other suitable arrangement for testing the operation of the indicators and alarm signal.

Detector heads should generally be fitted on the deck heads or ceilings of the spaces and should be set to operate at a temperature of  $155^{\circ}\text{F.} \pm 12^{\circ}\text{F.}$  except in drying rooms and similar spaces where a higher setting may be allowed. There should not be an excessive time lag in the operation of the alarm signal. Surveyors should satisfy themselves by a test that the time lag is within reasonable limits.

Spare detector heads should be carried in the proportion of not less than one for each fifty or part of fifty heads fitted in the installation with a minimum of six heads.

A list should be posted up adjacent to the indicating cabinet at the control station showing the actual cabin numbers, public rooms and other spaces included in each group, and the deck on which each group is situated. This will enable the officer on watch to instruct, without delay, the fire fighters and others concerned as to the location of a fire.

With each fire alarm and detection system the makers should supply to the ship full instructions as to the operation, maintenance and testing of the system.

### (4) *Submission of Plans and Particulars*

(a) Details of all fire alarm and detection systems to be fitted in the accommodation and service spaces of passenger ships should be submitted to the Engineer Surveyor-in-Chief, and should include particulars of the proposed system, detector heads, electric wiring diagrams, alarms, etc. Before a system is accepted, makers will be required to demonstrate the system and to carry out any test which may be considered necessary.

(b) Where it is proposed to fit a fire alarm and detection system which has been accepted it will only be necessary to submit to the Engineer Surveyor-in-Chief a general layout plan showing the grouping of the accommodation and service spaces and the way in which they are grouped, the position of all detector heads, the run of the electric or other power leads, the sources of power and the position of the indicators and alarms.

### (5) *Surveys and Tests*

When a fire alarm and detection system has been fitted in a ship, the Surveyor should satisfy himself that it has been installed in accordance with the approved plans. The various circuits, indicators and alarms should be checked by the operation of the testing arrangements mentioned in sub-paragraph (3) to see that the time lag is not excessive. An actual test of each group should be made, preferably by applying heat to one of the detector heads. The number of spare detector heads provided should be checked.

## 165. *Automatic Sprinkler, Fire Alarm and Detection Systems. (Rule 59)*

(1) Rule 59 requires that in ships in which Method II of fire protection has been adopted, an automatic sprinkler, fire alarm and fire detection system must be installed and that the system must comply with the requirements of the Sixth Schedule to the Rules.

## *(2) Submission of Plans and Particulars*

The following plans and particulars of the system should be submitted to the Engineer Surveyor-in-Chief at an early stage:

- (a) A general lay-out of the system showing the spaces including the position and size of all stairways (see paragraph 155) to be protected and the situation of the sprinkler heads in those spaces, the position of the water pump, air compressor and pressure tank, together with particulars of the capacity and H.P. of the pump.
- (b) The proposed sectional grouping and the position of the sectional shut-off valves.
- (c) The design of the air and water pressure tank, unless it is of a standard design already approved by the Ministry.
- (d) The position and type of the alarms.
- (e) For systems of a make not already accepted by the Ministry, full details of sectional control valves, alarms, sprinkler heads, etc., and details of materials used in the construction of the system.

## *(3) Charging of the System*

Paragraph 1 of the Schedule requires the system to be kept fully charged at all times, and this should be taken to mean fully charged with fresh water at the pressure necessary for automatic operation, not only while the ship is in service, but as far as practicable while the ship is laid up or under repair. When part of the system is being cleaned or repaired, the rest of the system should be capable of operating, if necessary by connection to an adequate shore water supply. (See paragraph 27(1) of the Report of the Working Party on Fire Prevention and Fire Fighting in Ships in Port).

## *(4) Pressure Tanks and Pipes*

- (a) Pressure tanks should, as regards strength and scantlings, comply with the Ministry's requirements for air pressure vessels, and the Surveyor should require proof that the appropriate material and hydraulic tests have been made. He should also ensure that the relief valve fitted in accordance with paragraph 2(a)(ii) of the Schedule cannot be isolated from the tank. The stop valves or cocks at the gauge glass connections on the tank should be kept shut except when ascertaining the water level or recharging the tank. An air pressure of not less than 70 lb. per square inch plus the pressure due to the head of water measured from the bottom of the tank to the highest sprinkler should be maintained in the tank.
- (b) The pipes of the system should be of steel of solid drawn, lap welded or other approved construction, and shall have been hydraulically tested by the makers to not less than 300 lb. per square inch. The pipes should not normally be placed in exposed positions but, if this is unavoidable, they should be suitable insulated.

## *(5) External Connections*

Where, in accordance with paragraph 2(d) of the Schedule, hose couplings with shut-off valves are provided for the purpose of coupling up the system to a shore water supply, the shut-off valves must be locked shut when the system is not actually coupled up to that supply. Similarly, the shut-off screw down non-return valve which must be fitted if a connection is provided from the ship's fire main to the system must normally be kept locked shut.

## *(6) Pumps*

The sea suction to the pump should be so arranged that, when the ship is afloat, it will not be necessary to shut off the supply of sea water to the pump for any purpose other than the inspection or repair of the pump.

### *(7) Sprinkler Heads*

Sprinkler heads used in the system should be of a type accepted by the Ministry as complying with paragraphs 2(f)(iv) and (v) of the Schedule.

With regard to the requirements of paragraph 2(f)(i) of the Schedule, it may be desirable, at the extreme ends of the ship, to allow a section of sprinkler heads to be split by watertight or fire-proof bulkheads or to serve more than two decks. This will usually avoid the necessity of having a section or sections consisting of a very small number of sprinklers. Also, in certain cases, it may be desirable to protect a stairway by sprinklers from a section separated from the stairway by a watertight or fire-proof bulkhead.

Some latitude may also be allowed in the maximum number of 150 sprinkler heads prescribed for a section where this is considered to be justified having regard to all the circumstances.

To meet the requirements of paragraph 2(g) of the Schedule, sprinkler heads must be placed sufficiently clear of beams and other objects to satisfy the Surveyor that all combustible material in the space will be effectively sprayed; where beams, etc., are widely spaced, sprinkler heads need not be placed any lower than is necessary to meet this requirement. The Surveyor should also ensure that a supply of spare sprinkler heads is provided in accordance with the requirements of paragraph 2(f)(vi) of the Schedule.

### *(8) Automatic Alarms*

The audible alarm signal provided in accordance with paragraph 2(h) of the Schedule to give warning at the control stations when a sprinkler operates should be clearly distinguishable from any signal given by manually operated or other alarm devices fitted in the ship.

### *(9) Power Supply and Electrical Connections, etc.*

The requirements regarding the power supply, leads and switches for sprinkler systems are set out in Rule 38(5) (see also paragraph 142 of these Instructions).

### *(10) Tests of New Sprinkler Systems and Routine Tests in Service*

(1) The following tests should be applied by the Surveyor to a new sprinkler system after it has been installed in the ship:

- (a) Tests to ensure that all pipes are clear and properly coupled up.
- (b) The piping, with the sprinkler heads in position, should be tested by hydraulic pressure to not less than twice the maximum working pressure of the system.
- (c) A test to ensure that the pump cuts in automatically should be made. A note should be made of the pressure drop in the tank when the pump cuts in.
- (d) The automatic alarms are to be tested :
  - (i) by opening in rotation the test valve at each sectional control station; and
  - (ii) by the local switches provided at the central control station.
- (e) The pump should be operated with the 2 inch valve on the discharge open to ensure that the pressure required by paragraph 2(e)(iv) of the Schedule is maintained. The actual discharge pressure maintained during the test should be noted.
- (f) The setting of the pressure relief valve on the pressure tank and its ability to prevent overpressure when the air compressor or re-charging pump is working, should be checked.



(2) While the ship is in service, the above tests (c) to (f) should be made every week by the ship's officers, and care should be taken to see that the level of fresh water in the pressure tank is again brought up to the correct height immediately after the tests have been made. All sprinkler heads should be examined periodically by the ship's officers for possible damage or loss of coloured liquid and faulty sprinkler heads renewed without delay.

*(11) Instructions to be given to the Master*

Surveyors should see that a diagrammatic plan of the sprinkler system showing the various decks and spaces served, and comprehensive instructions regarding the maintenance, testing and operation of the system are supplied to the master of the ship and that the plan is properly exhibited. (see paragraph 164(3)).

**166. *Incombustible Material.* (Rule 60)**

Materials intended for use as incombustible material must be tested in the presence of a Ministry Surveyor at the Fire Testing Station of the Department of Scientific and Industrial Research and Fire Offices Committee, Joint Fire Research Organisation, Boreham Wood, Herts. A copy of the result of the test should be sent by the applicant to the Chief Ship Surveyor. Surveyors will be advised of the incombustible materials which have been accepted.

**167. *Structure of the Ship.* (Rule 62)**

For the purpose of this Rule, wood will not normally be accepted instead of steel. If metals other than steel are proposed, e.g. aluminium alloy, full particulars should be submitted to the Chief Ship Surveyor for consideration.

**168. *Separation of Machinery Spaces from Accommodation and Service Spaces.* (Rule 63)**

Application for the use of material other than steel for the "A" class divisions in ships of Classes V, VI and VI(A) will be considered provided that the divisions are insulated to the satisfaction of the Ministry. Full particulars of each case should be submitted to the Chief Ship Surveyor.

"Machinery spaces" in this Rule means the spaces in which the boilers and machinery for the propulsion of the ship are situated and associated spaces.

**169. *Periodic Surveys***

*Class A and B Divisions*

An examination is to be made of all Class A and Class B divisions and in particular the Surveyor should satisfy himself that the efficiency of the insulation of the Class A divisions has not been impaired. For the proper examination of the insulation, the Surveyor is to have removed such parts of linings, etc., as he may consider necessary to enable him to check that the insulation is properly attached to the steel structure.

All doors and other means for closing openings in Class A and Class B divisions should be inspected and their condition and efficiency checked. The Surveyor should see that the means for operating dampers in ventilation and other trunkways are in proper working order.

He should check that any repainting is in accordance with paragraphs 3 and 4 of Rule 54.

If any alterations are made to the Fire Protection arrangements the Surveyor should see that the plan required under Rule 43 is suitably amended.

### *Automatic Fire Alarm Systems (other than Sprinkler Installations)*

The operation of the indicators and alarm signals should be tested by the means provided to comply with paragraph 164(3). It should be seen that the list showing cabins, etc., as required by paragraph 164(3) is in place, that the spare detector heads and maker's instructions are on board as required by the same paragraph.

### *Sprinkler Installations*

A general inspection of the system should be made; the pressure tank should be inspected internally at suitable intervals. Tests (c) to (f) of paragraph 165(10)(1) are to be made and it should be seen that the diagrammatic plan required by paragraph 165(11) is displayed and that a supply of spare sprinkler heads as required by paragraph 2(f)(VI) of the Sixth Schedule to the Rules and a copy of the maker's instructions are on board.

### *Cinema installations*

Where inflammable films are provided for exhibition on board the ship the Surveyor should see that the general precautions laid down in paragraph 163 are complied with. In particular he should see that the fire appliances (sub-paragraph (9)), notices prohibiting smoking (paragraph (8) Fifth Schedule) and the marking of exits (paragraph (1) Fifth Schedule) are in accordance with the requirements.

### *169a. Aluminium Alloy Superstructures*

Where Method 11 of fire protection is employed in a passenger ship, the superstructure of which is constructed of aluminium alloy, and which otherwise complies with the Merchant Shipping (Construction) Rules, 1952 and with the Merchant Shipping (Fire Appliances) Rules, 1952, the following arrangements will apply:—

- (a) A second sprinkler pump arranged for automatic starting is to be provided, together with a pressure storage tank, to be situated in an approved position reasonably remote from the boiler and machinery spaces and from fuel tanks and the other sprinkler pump, and where it has ample protection against damage by frost. This second pump and tank are to be connected to the main sprinkler distribution system. The source of power for the second pump is to be from a direct coupled automatic starting diesel engine. Any other independent source of power may be considered provided there are short independent leads to the second sprinkler pump arranged to avoid risk of damage by fire or other emergency, and provided that automatic starting of the pump is ensured. Alternatively, the emergency generator may be considered as the source of power provided it is situated in an approved position and that it is designed to take the necessary additional load.
- (b) In addition to any fixed installation provided under Rule 7(4) of the Fire Appliances Rules there is to be provided a system of smothering gas or water spray capable of distribution throughout every space where liquid fuel is used, including diesel engine rooms. If the fixed installation itself uses smothering gas or water spray, an increase in its capacity will serve the same purpose. This additional provision need not be required to deal with more than one watertight compartment at one time. Particular stress will be laid on the means provided for closing such spaces and the speed with which they operate.

The foregoing is also recommended for steam turbine engine rooms, though where these are separated by a watertight subdivision from the boiler room and contain no diesel machinery, an extension of the boiler room system can be used to provide CO<sub>2</sub> or water spray, with

the addition of 2, 10 and 30 gallon foam extinguishers. Auxiliary machinery spaces in separate watertight compartments which do not contain diesel machinery, such as steering gear compartments, stabilizer rooms, refrigerating machinery spaces, etc. will require no fire appliances except one or two two-gallon extinguishers.

- (c) Crowns and casings of boiler and machinery spaces are to be of steel construction adequately insulated, and the openings suitably arranged and protected to prevent spread of fire. Difficulties are foreseen in providing equivalent protection where it is desired to use aluminium for these parts, and proposals of this kind will be subject to critical examination.
- (d) The insulation of the Class "A" divisions at present required by the Rules is to be adjusted as necessary to prevent a maximum temperature rise in the aluminium construction exceeding 200°C. if the structure is load-bearing, and 300°C. otherwise.
- (e) Care is to be taken to ensure that in the event of fire, boat launching arrangements remain as effective as if the superstructure were constructed of steel.

In the case of a Method I or III ship in which the construction of the superstructure in aluminium alloy is contemplated, the proposed arrangements should be submitted to the Chief Ship Surveyor.



## PART VI

# Boilers and Machinery

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### Chapter I

#### GENERAL

##### 170. *Surveys: General*

(a) Part VI of the Rules sets out the requirements with which the boilers and machinery of a ship must comply. Section 286 of the Merchant Shipping Act, 1894, prescribes that the weight on the safety valves may not be increased beyond the limits fixed by the Surveyor.

(b) The following are to be surveyed during construction and at periodic surveys: main and auxiliary boilers, superheaters, economisers, evaporators, feed heaters, feed filters, air receivers and other pressure vessels; the arrangement and drainage of steam pipes; the arrangement of air pressure and feed pipes; the main engines and shafting and all auxiliary machinery essential for propelling the ship and to meet safety requirements; the steering gear and oil fuel installations. Watertight doors, bilge pumping arrangements and electrical equipment and installations must comply with the requirements of Part VI of the Rules so far as they are applicable, as well as the provisions of Part II, Part III and Part IV respectively.

(c) Surveyors should be satisfied that boilers used in connection with loading or unloading the ship, or used exclusively for purposes unconnected with the propelling power of the ship, are safe for the pressure at which they are worked.

(d) Copies of orders for machinery or parts of machinery to be made in other districts and requiring survey during or after construction, should be obtained and forwarded to the Surveyors concerned.

##### 171. *Initial Surveys*

(a) The initial survey of boilers and machinery should cover all the items mentioned in paragraph 170(b). For Periodic Surveys see Chapter 15.

Plans and particulars of the items mentioned in paragraph 170(b), together with particulars of the estimated power available for going astern, should be submitted to the Engineer Surveyor-in-Chief.

Electrical installations should comply with the Regulations for the Electrical Equipment of Ships, 1939 and the Supplement of 1947 issued by the Institution of Electrical Engineers (see Part IV of the Rules and Part IV of these Instructions).

For Motor Launches of Classes V, VI and VI(A) plans showing the general arrangement of the machinery and fuel tanks, engine casing, means of preventing the spread of oil from the engine space, and the fuel tank capacity, should be submitted to the Engineer Surveyor-in-Chief.

If, during construction, any deviation from an approved plan is proposed full particulars should be submitted to the Engineer Surveyor-in-Chief.

When a Surveyor has inspected boilers and other pressure vessels and machinery during construction, it will not normally be necessary, before issuing the declaration, to have them opened up on board the ship for re-examination.

Surveyors should not accept any new or unusual arrangements or construction of boilers, machinery, fittings or equipment without first referring the matter to the Engineer Surveyor-in-Chief.

(b) Where a passenger certificate is required in respect of a ship not constructed under the Ministry's survey, plans covering the items detailed in paragraph 170(b) should be submitted to the Engineer Surveyor-in-Chief with the Surveyor's report on the condition and sufficiency of the various parts. Where other methods are not available, the Surveyor may use his discretion in regard to drill testing to check the scantlings of boilers and other pressure vessels. The owner should provide information regarding the quality of the material used in the construction of the parts under survey.

(c) Before a declaration is issued, trials of the machinery must be witnessed by a Surveyor. In the case of new ships, the trials should be made at sea or under conditions which approximate to those of the service in which the ship will be engaged. The main and auxiliary steering gear should be tested during the trials at sea.

(d) If any item, the design of which has been accepted, proves unsatisfactory during manufacture or in use, particulars of the defects should be reported to the Engineer Surveyor-in-Chief.

## Chapter 2

### MANUFACTURE, QUALITY AND TESTS OF MATERIAL

#### 172. *Material to be Tested*

Steel used in the construction of boilers, superheaters, economisers, and other pressure vessels and for the more important forgings and castings of the machinery, and bronze used for shafting and for special purposes, are to be tested in the presence of a Surveyor. The tests should be carried out on testing machines of which the details have been approved by the Engineer Surveyor-in-Chief and of which the accuracy has been verified by the Surveyors within the preceding twelve months (see also Appendix V). If no such tests are made the Surveyor should not give a declaration covering the parts concerned without first referring the case to the Engineer Surveyor-in-Chief.

#### 173. *Copies of Orders*

When any new part, the material of which is required to be tested, is ordered for a passenger ship under the Ministry's survey, the owners or contractors should send a copy of the order to the local Marine Survey Office and request the makers to see that arrangements are made for a Surveyor to witness the tests.

Surveyors receiving copies of orders for material which is required to be tested should forward them together with a letter of advice and particulars of fees paid, with as little delay as possible to the Surveyors who are to witness the tests.

The makers of the part or parts should give ample notice to the local Surveyors when the articles are ready for the selection of test pieces and when these are ready for testing.

#### 174. *Process of Manufacture*

Carbon steel intended for use in the construction of boilers, superheaters, economisers and other pressure vessels and for forgings and pressure pipes is to be made by the open-hearth or an electric process, acid or basic. In the case of steel castings the steel may be made by any process recognised by the Ministry.

Where steel intended for boilers is not produced in the works at which it is rolled, a certificate must be supplied to the Surveyor who will witness the material tests, stating the process by which it was made, the name of the steel maker who supplied it and the steel maker's charge numbers.

#### **175. *Heat Treatment of Thick Plates***

It is desirable that all plates over  $1\frac{1}{2}$  inches in thickness and not intended for hot working should be normalised before the test pieces are cut off. In every case where the thickness of a plate exceeds  $1\frac{3}{4}$  inches the plate must be normalised before the test pieces are cut off.

#### **176. *Alloy Steel***

Alloy steel intended for use in the construction of boilers and machinery should be made by the open hearth or other process recognised by the Ministry. The analysis and physical properties and details of the proposed physical tests should be submitted to the Engineer Surveyor-in-Chief for approval.

#### **177. *Freedom from Defects, etc.***

Finished material should be sound and free from cracks, flaws and laminations; no hammer-dressing is permissible. Patching, burning or electric welding (see paragraph 186) should not be allowed without the prior approval of the Engineer Surveyor-in-Chief.

#### **178. *Branding***

Plates, bars and sections should be stamped with the maker's name or trade mark and every article should be stamped with a number or mark in order that the charge of steel from which it was made can be identified.

#### **179. *Selection and Treatment of Test Pieces***

(a) All the test pieces required should be selected and stamped by the Surveyor, and, except where otherwise specified in these Instructions, the tests should be made in his presence at the place of manufacture and on accepted testing machines, before the despatch of the material.

(b) Test pieces should not, in general, be cut off forgings, castings, plates, bars or sections until they have been stamped with the Surveyor's stamp and any heat treatment has been completed.

If by special arrangement any material is heat-treated after test pieces have been selected and cut off, the test pieces should be simultaneously treated with the material in the same furnace before they are tested.

(c) When a number of articles are cut from one plate, bar or forging, the tests required should be only those required from the original piece, provided the articles have not been further heated or forged, and can be identified as having formed part of the original piece.

(d) When a number of small forgings are made from the same ingot, or a number of small castings from the same charge of steel, tensile and bend tests at the rate of one of each for every four articles will, as a rule, be sufficient. (See also paragraphs 195(a) and 203).

(e) Except where specially mentioned in these Instructions any straightening of test pieces which may be required should be done cold. (See paragraph 209).

#### **180. *Standard Test Pieces***

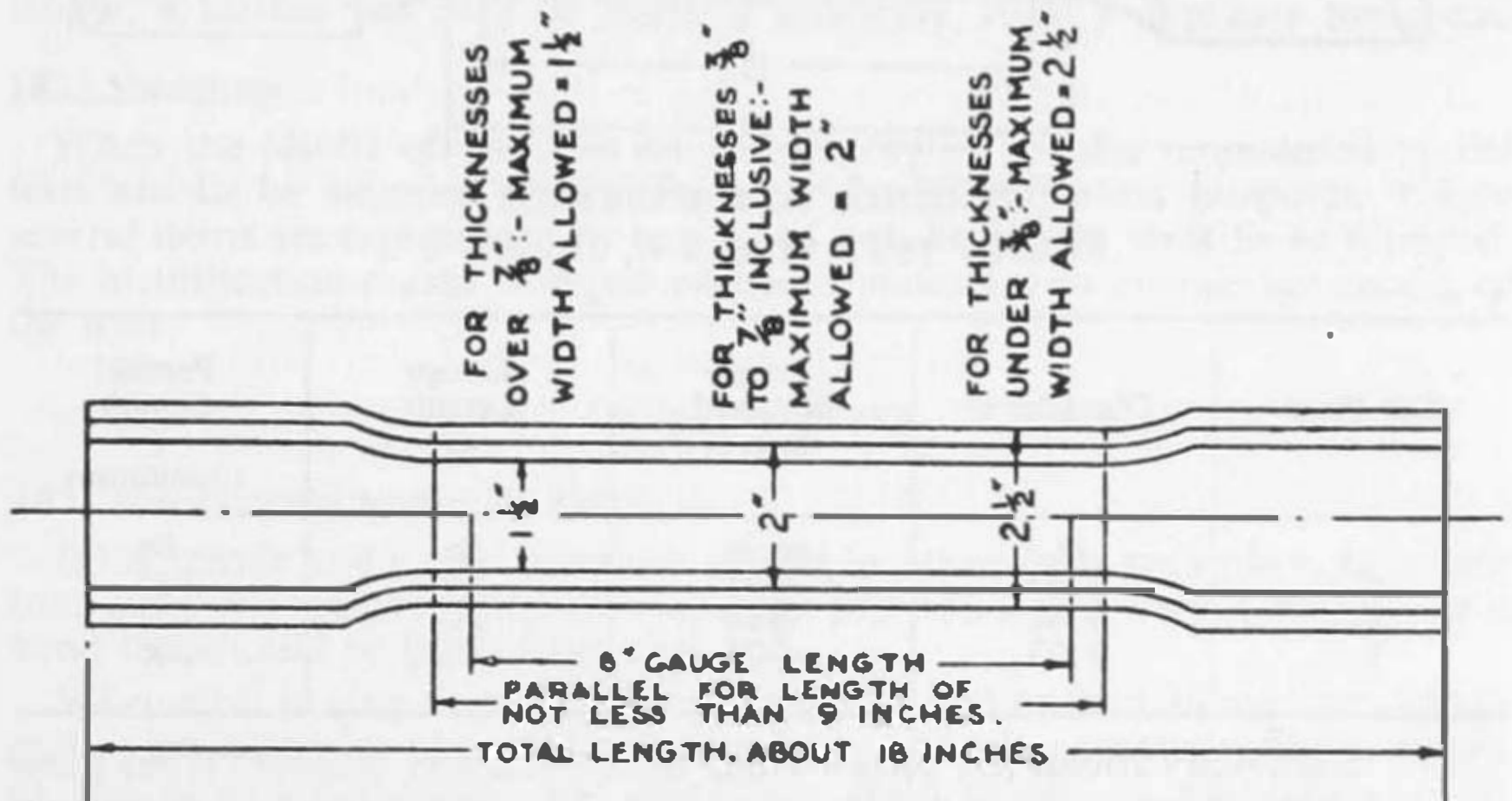
The forms and dimensions of test pieces should be as follows:

##### **(a) *Tensile Tests***

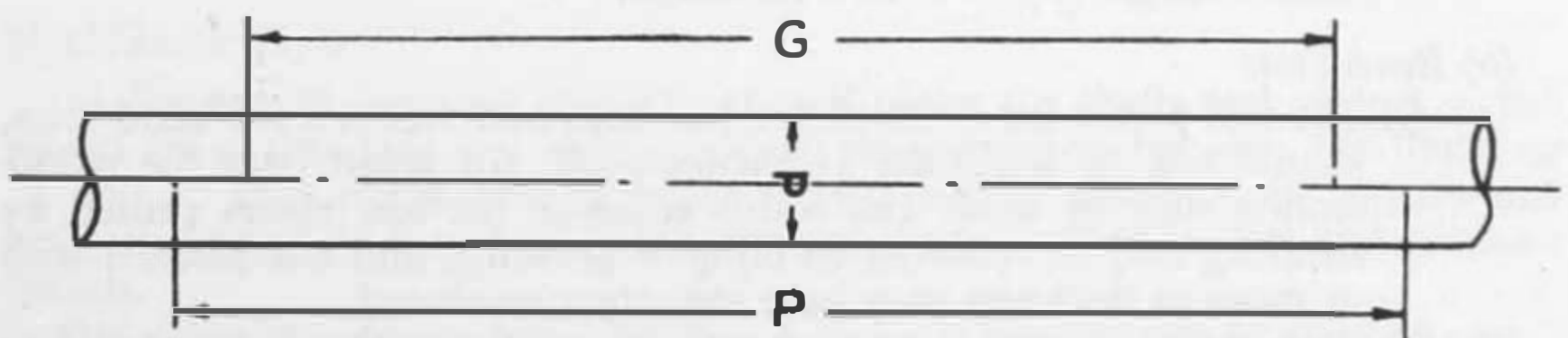
The gauge length and parallel portion of the tensile test pieces should be as shown below.



Any reduction of the test pieces to the form required should be effected by machining and, wherever practicable, the rolled surfaces should be retained on two opposite sides of the test pieces taken from plates and sections.



PLATES AND SECTIONS  
FLAT TEST PIECE A

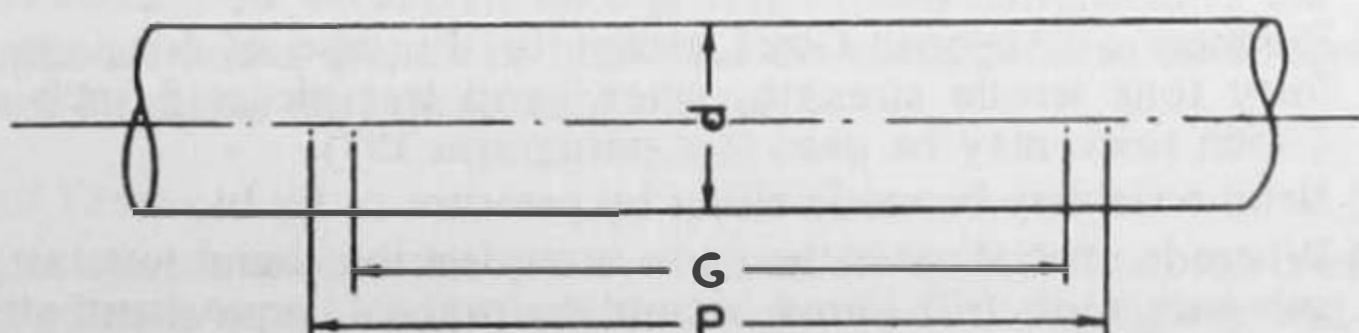


GAUGE LENGTH  $G = 8 \times d$   
LENGTH BETWEEN GRIPS, P, TO  
BE NOT LESS THAN  $9 \times d$

ROUND BARS

ROUND TEST PIECE B

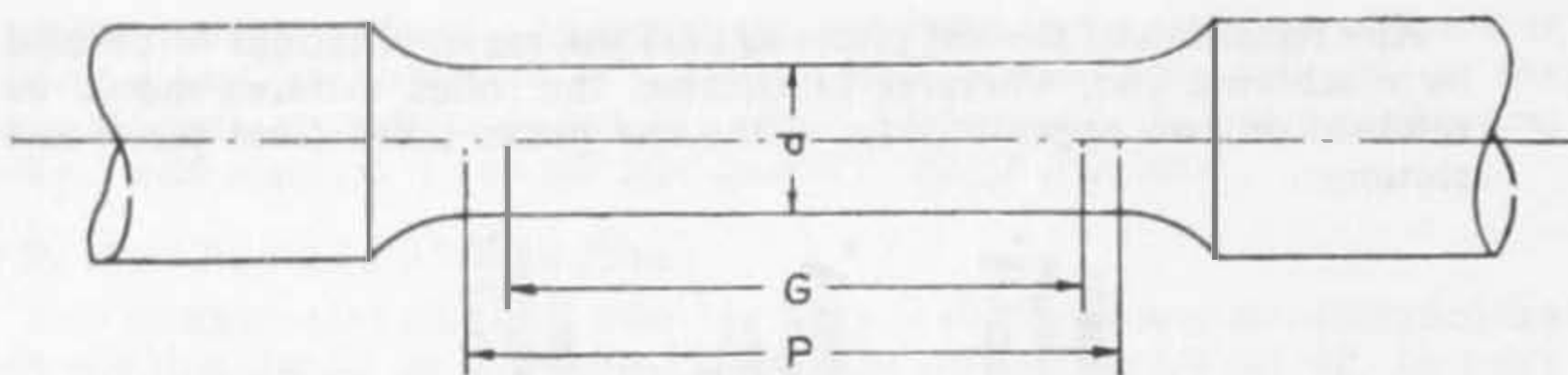
*For test pieces not exceeding 1 inch in diameter*



GAUGE LENGTH  $G = 4 \times d$   
LENGTH BETWEEN GRIPS, P, TO  
BE NOT LESS THAN  $4.5 \times d$

ROUND TEST PIECE B1

*For test pieces exceeding 1 inch in diameter*



FORGINGS AND CASTINGS  
ROUND TEST PIECES C, D AND E

Test Piece	Diameter d	Cross Sectional Area A	Gauge Length G	Parallel Length P (minimum)
C	in. 0.564	sq. in. 0.25	in. 2.0	in. 2.25
D	0.798	0.50	3.0	3.375
E	0.977	0.75	3.5	4.00

Subsidiary round test pieces which have diameters different from those of test pieces C, D and E may be used. The proportions of these subsidiary test pieces should be as given below

$$\text{Gauge length (G)} = 3.54 d$$

$$\text{Parallel length (P)} = 3.98 d \text{ minimum}$$

#### (b) Bend Tests

- (i) The test pieces cut from plates, flat bars and sections for bend tests, should not be less than  $1\frac{1}{2}$  inches wide; for small bars the whole section may be used. The rough edges of the test pieces caused by shearing may be removed by filing or grinding, and test pieces 1 inch or more in thickness may have the edges machined.
- (ii) Whenever practicable the rolled surfaces should be retained on two opposite sides of the test pieces. The bend test pieces of round bars should be of the full diameter of the bars as rolled.
- (iii) The bend tests of mild steel forgings and steel castings should be made with rectangular test pieces 1 inch wide by  $\frac{3}{4}$  inch thick, which are to be machined to size and have the corners rounded to a radius of  $\frac{1}{8}$  inch; they are to be bent over their thinner section. Alternatively, for steel castings the bend test pieces may be 1 inch in diameter.

Generally, in the case of high tensile steel, proposals in regard to the dimensions of bend test specimens are to be submitted to the Engineer Surveyor-in-Chief except in the case of forgings of over forty tons tensile strength, when bend test pieces  $\frac{3}{4}$  inch wide by  $\frac{1}{2}$  inch thick may be used (see paragraph 197).

- (iv) Bend tests may be made either by pressure or by blows.
- (v) Where in special cases the makers request that bend tests as given in sub-paragraph (iii) above should be waived, equivalent alternative bend tests will be required. All such cases are to be submitted to the Engineer Surveyor-in-Chief.

#### 181. Material Retests

(a) If a test piece fails, two duplicate test pieces may be tested and if the results obtained from both are satisfactory the material may be accepted.

Should the test piece or one of the retests fail and it is considered that the heat treatment has been unsatisfactory, the material may be again heat-treated and re-submitted for tests.

(b) Should a tensile test piece break outside the middle half of its gauge length, a further test may be made, if necessary, from a duplicate test piece.

## **182. Stamping**

When the results of the tests are satisfactory all articles represented by the tests are to be stamped by the Surveyor for identification purposes. Where several items are represented by one set of tests each item must be so stamped. The identification marks stamped on boiler plates are to include the results of the tests.

## **STEEL PLATES**

### **183. Number and Nature of Tests**

(a) A tensile and a cold bend test should be taken from each plate, as rolled; but, when the weight of the plate exceeds two and a half tons, a tensile and a bend test should be taken from each end.

When steel having a specified tensile strength higher than 35 tons per square inch is proposed for plates intended for boilers or other pressure vessels, details of the proposed material and mechanical tests should be submitted to the Engineer Surveyor-in-Chief for consideration.

(b) Test specimens may be cut from the rolled material either lengthwise or crosswise.

### **184. Tensile Tests**

(a) The tensile breaking strength of steel plates for shells and girders, determined from standard test pieces, should ordinarily be between the limits of 28 and 35 tons per square inch for riveted boilers and pressure vessels and between 26 and 35 tons per square inch for fusion welded boilers and pressure vessels.

The range should not be more than 4 tons per square inch in any one case.

(b) For plates intended for flanging or forge welding and for combustion chambers and furnaces, the tensile breaking strength should ordinarily be between the limits of 26 and 30 tons per square inch.

(c) The elongation, measured on a standard test piece having a gauge length of 8 inches, should be not less than 20 per cent, for material of  $\frac{3}{8}$  inch in thickness and upwards required to have a tensile breaking strength between the limits of 28 and 35 tons per square inch, and not less than 23 per cent. for material of  $\frac{3}{8}$  inch in thickness and upwards required to have a tensile breaking strength between the limits of 26 and 30 tons per square inch.

For material under  $\frac{3}{8}$  inch in thickness the elongation in each case may be 3 per cent. less than that mentioned above.

### **185. Bend Tests**

Bend test pieces should withstand, without fracture, being bent cold until the internal radius is equal to  $1\frac{1}{2}$  times the thickness of the test piece and the sides are parallel.

### **186. Inspection of Plates**

Surface defects on plates may, with the sanction of the Surveyor, be removed by chipping, filing or grinding, but not by hammer-dressing, patching, burning or electric welding. Boiler shell plates treated by local dressing should be stamped



at an adjacent part with the Surveyor's initials after he is satisfied that the defect has been completely removed without undue thinning of the plate. The action taken should be reported with the test results on form Surveys 24 (see paragraph 213).

SECTION, RIVET AND STAY BARS

187. *Number and Nature of Tests*

(a) Tensile tests in the following proportions should be made from bars of each diameter or section from each charge from which they are rolled.

	Number of bars from one charge	Number of Tests
Sections, all sizes, and round bars over 1½ inches diameter	8 or less	1
	9 to 15	2
	For each additional 15 or part thereof	Add 1
Bars 1½ inches dia- meter and under	20 or less	1
	21 to 50	2
	For each additional 25 or part thereof	Add 1

(b) Cold bend tests should be made from round bars in the same proportion as that in which tensile tests are required, but no bend tests need be made from rivet bars. In the case of sections, a cold bend test should be made from each bar rolled. (See paragraph 190 for tests of special iron intended for combustion chamber stays).

188. *Tensile Tests*

(a) Longitudinal stays should have a tensile strength between the limits of 28 and 35 tons per square inch, with an elongation of not less than 20 or 24 per cent. measured on standard test piece B or B1 respectively. The range should not be more than 4 tons per square inch in any one case.

(b) Combustion chamber stays should have a tensile strength between the limits of 26 and 30 tons per square inch, with an elongation of not less than 23 or 28 per cent. measured on standard test piece B or B1 respectively.

(c) Section bars should have a tensile strength between the limits of 28 and 32 tons per square inch, with an elongation of not less than 20 per cent measured on the standard test piece A.

For material under ¾ inch in thickness the elongation may be 3 per cent. less.

(d) Rivet bars should have a tensile strength between the limits of 26 and 30 tons per square inch, with an elongation of not less than 25 or 30 per cent. measured on standard test piece B or B1 respectively. The bars may be tested the full size as rolled.

189. *Bend Tests*

The test pieces should withstand, without fracture, being bent cold until the internal radius is equal to 1½ times the thickness or diameter of the test piece and the sides are parallel.

### 190. *Iron Combustion Chamber Stay Bars*

Iron screw stays of the same size as would be required for mild steel may be accepted if they withstand the following tests:

- (a) The bars as rolled of each diameter are to be placed in batches of 20, and one tensile and two bend test pieces are to be selected by the Surveyor from each batch.
- (b) The tensile breaking strength should not be less than  $21\frac{1}{2}$  tons per square inch with an elongation of not less than 25 or 30 per cent. measured on standard test piece B or B1 respectively.  
If the tensile test is unsatisfactory, two other bars may be selected for test from the batch, and should either of these fail the batch is to be rejected.
- (c) The bend test pieces may be either of the bar as rolled or turned down to one inch diameter. One of the two bend test pieces selected is to be lightly and evenly nicked on one side with a sharp cutting tool.

The unnicked bend test piece should bend cold without fracture until the sides are parallel and the space between the two sides is not greater than the diameter of the test piece. The nicked test piece is to be bent back at the nick through an angle of  $180^\circ$  by pressure or by a succession of light blows. The fracture should not show any coarse crystalline structure and should be fibrous and free from slag or dirt.

If either of the bend tests is unsatisfactory, two other bars may be selected and similarly tested. Should either of these bars prove unsatisfactory the batch is to be rejected.

### 191. *Rivets*

(a) A few rivets of each size should be selected by the Surveyor from the bulk, and should be subject to the following tests:

- (i) The rivet shanks are to be bent cold and hammered until the two parts of the shank touch, without fracture on the outside of the bend.
- (ii) The rivet heads are to be flattened, while hot, until their diameter is two and a half times the diameter of the shank, without cracking at the edges.

(b) Where the Surveyor considers it necessary, check tensile tests of shell rivets should be made. The elongation should, when practicable, be taken in a length of two and a half times the diameter of the prepared part; the tensile strength should be from 26 to 32 tons per square inch and the contraction of area about 60 per cent.

## BOILER TUBES

### 192. *Tubes subject to Internal Pressure*

(a) *Manufacture and Heat Treatment.* All tubes subject to internal pressure should be seamless except where other types have been submitted to and accepted by the Engineer Surveyor-in-Chief. They should be made of mild steel produced by the open hearth or electric process and contain not more than 0.05 per cent. of sulphur or of phosphorus or be made of half per cent. molybdenum or chromium-molybdenum steel to British Standard specifications 1652:1950 or 1653:1950. All tubes shall be well finished, clean and free from

harmful defects. They should be reasonably straight, smooth, cylindrical and within the following tolerances:

Outside diameter in inches	Permissible tolerance			
	On outside diameter		On thickness	
	Hot finished	Cold drawn	Hot finished	Cold drawn
Up to and including 2½	+ 1/64 inch - 1/32 inch	+ 0 - 1 per cent. All diameters	+ 17½ per cent. - 7½ per cent.	+ 10 per cent. - 5 per cent. All diameters
Over 2½ up to and including 4½	± 1 per cent.		+ 15 per cent. - 5 per cent.	
Over 4½			+ 17½ per cent. - 7½ per cent.	

After cold drawing mild steel tubes should be suitably heat treated throughout their length and the ends should be annealed after any local operation of swelling or reducing.

The ends of hot finished mild steel tubes should be annealed for a length of not less than 6 inches at each end for expanding.

Alloy steel tubes should be suitable heat treated.

(b) *Mechanical Tests.* Tubes should be presented in batches of 100, plus, if so desired, an allowance for the tubes to be selected for the tests.

Two tubes should be selected indiscriminately from each of the first four batches and one from each of any remaining batches of 100 tubes or part thereof. The lengths of material requisite for all the test pieces for the mechanical tests should be taken from the tubes selected.

(c) *Tensile Tests.* The tests may be made from strips cut from tubes and tested in their curved condition, or from a complete portion of the tube, the ends being plugged for grips.

The results of the tensile tests should comply with the following requirements:

Type of Steel	Type of Test piece	Ultimate tensile strength tons per square inch		Minimum elongation per cent.			
				On 8 inches		On 2 inches	
		Minimum	Maximum	½ in. thick and over	Less than ½ in. thick	½ in. thick and over	Less than ½ in. thick
Mild steel	Cut strip	20	28	20	18	30	28
	Full tube	20	28	25	23	—	—
Alloy steel	Cut strip	25	33	19	17	25	23
	Full tube	25	33	23	21	—	—

(d) *Flattening Tests.* A ring not less than 2 inches in length, taken from one end of each selected tube, should be flattened between two parallel surfaces the width of which should be not less than 1½ times the specified outside diameter



of the tube. When the pressure is released, the specimen should comply with the following requirements and show no sign of crack or flaw:

Nominal thickness of tube	Distance apart of inner surface at mid length after release of pressure	
	Hot finished mild steel. Hot finished and cold drawn alloy steel	Cold drawn mild steel
Thicker than 10 S.W.G.	3 times thickness	2 times thickness
10 S.W.G. and thinner		Nil, i.e. inner surfaces meeting

(e) *Expanding Tests.* A test piece taken from one end of each selected tube should be capable of being expanded symmetrically by a drift expander having a total included angle of from 40 to 60 degrees, to the following increases in outside diameter, without showing any signs of crack or flaw:

Type of steel	Nominal thickness of tube in S.W.G.	Increase in outside diameter per cent.
Mild steel	6 and thinner	15
	Thicker than 6 up to and including 3	12
	Thicker than 3	9½
Alloy steel	10 and thinner	12½
	Thicker than 10 up to and including 6	9½
	Thicker than 6	6½

(f) *Duplicate Tests.* Should any of the specimens show definite signs of failure in one or more of the tests specified in (c), (d) and (e) two further tests of the same kind may be made from two additional tubes selected from the same batch. Should either of these tubes fail to satisfy any of the tests, the batch of tubes may be heat-treated and then retested in accordance with (c), (d) and (e), but twice the number of test pieces should be selected. If all the repeat tests are satisfactory the batch may be passed, but if failure again occurs the tubes represented should be rejected.

(g) *Hydraulic Tests.* Every tube should be tested at the tube makers works by hydraulic pressure in accordance with the following table:

Working pressure of boiler lb. per square inch	Hydraulic test pressure lb. per square inch
Up to and including 500	1000
Above 500 up to and including 1000	2 × working pressure
Above 1000	Working pressure + 1000

The manufacturer's certificate covering the hydraulic tests may be accepted.

### 193. *Iron and Steel Tubes subject to External Pressure*

A few bending tests may be made from the scrap ends of the stay tubes or the strips from which they are made, but special tests need not be made from the tubes fitted into boilers under the Ministry's survey if the general nature of the material is found satisfactory.

## STEEL FORGINGS OTHER THAN SEAMLESS DRUMS

### 194. *General*

Sufficient discard should be made from the top and bottom of each ingot to ensure that the forgings made from it will be sound. For important forgings the sectional area of the body of the forging should not exceed one fifth that of the original ingot and no part of the forging should have a sectional area more than two-thirds that of the ingot except that in the case of ingots cast in chilled moulds with the larger cross section uppermost and with efficient refractory feeder heads, the sectional area of any part of the forging is not to exceed :

One third of the sectional area of the ingot where the length at any diameter is greater than its diameter.

Two thirds of the sectional area of the ingot where the length at any diameter is less than its diameter.

All steel forgings should, after completion and before the test pieces are selected, be suitably heat-treated; if any subsequent heating is done, the Surveyor may require the forgings to be heat-treated again.

### 195. *Number and Nature of Tests*

(a) At least one tensile and one bend test should be taken from each forging, but if the weight exceeds three tons, a tensile and a bend test should be taken from each end. Small forgings made from one ingot may be dealt with under the provisions of paragraph 179(d) but batches of forgings or stampings (connecting rods, small crank shafts, etc.) should, in general, be dealt with in accordance with the following scale:

Weight of each forging or stamping	Number from one ingot	Number of tensile and bend tests
Up to 10 lb.	50 or less	1 in 50
	more than 50	1 in 100
Above 10 lb. and not exceeding 56 lb.	20 or less	1 in 10
	more than 20	1 in 20
Above 56 lb. and not exceeding 112 lb.	16 or less	1 in 8
	more than 16	1 in 16
Above 112 lb. and not exceeding 224 lb.	8 or less	1 in 4
	more than 8	1 in 8

(b) The test pieces should be taken from a part of the forging of a sectional area not less than that of the body and they should be machined to size without further forging. Where the couplings of a shaft are formed by "upsetting", the test pieces may be cut from the outer edge of the couplings.

(c) If the webs of built crankshafts are forged or rolled from ingot steel, the test pieces are to be taken transversely from the webs as forged or rolled.

## 196. Tensile Strength and Elongation

The tensile strength of steel forgings should normally be between the limits of 28 and 40 tons per square inch with a difference of not more than 4 tons per square inch in any one forging. The elongation, measured on the appropriate standard test piece, C, D, or E, should not be less than 17 per cent. for 40 tons steel; and in no case may the sum of the tensile strength and the corresponding elongation be less than 57 for test pieces cut longitudinally or 52 for test pieces cut transversely.

## 197. Bend Tests

The test pieces should withstand being bent cold without fracture through an angle of 180°, the internal radius of the bend being not greater than that given below:

Maximum specified tensile strength of forging	Internal radius of piece after bending
Up to 32 tons per square inch	$\frac{1}{2}$ inch
Above 32 tons and up to 36 tons per square inch	$\frac{3}{8}$ inch
Above 36 tons and up to 40 tons per square inch	$\frac{1}{2}$ inch
Above 40 tons where the special $\frac{3}{4}$ inch by $\frac{1}{2}$ inch test piece is used (see paragraph 180(b)(iii))	$\frac{3}{4}$ inch

## SEAMLESS STEEL DRUMS FOR BOILERS

### 198. General

Sufficient discard should be made from the top and bottom of each ingot to ensure soundness in the portion used for the forging. Sulphur prints may be taken to show that this condition has been fulfilled.

The drum should be made from a solid cast ingot, punched, bored or trepanned; alternatively hollow cast ingots may be used. The resultant wall in the case of the solid cast ingot, or the wall of the hollow cast ingot, should be reduced in thickness by at least one half in the process of forging.

Each drum should be efficiently heat-treated during manufacture, as necessary, and on completion of the forging process.

### 199. Number and Nature of Tests

Sufficient material should be left on the open ends of each forging to enable transverse test pieces to be taken. The tests should consist of not less than one tensile and one bend test from each open end. In the case of open ended drums the test material should not be cut off before heat treatment; if the drum ends are to be closed in, the test pieces may be cut off immediately before this operation; subsequently the test pieces and drum forgings should be simultaneously heat-treated in the same furnace.

Prior to heat-treating the test pieces with the drum, the test pieces may be heated for the purpose of straightening but the sectional area must not be altered during this operation.

In the case of seamless drums which have an unpierced blind end, check tensile and bend tests should occasionally be made by Surveyors from material taken from the blind end and the results of the tests reported to the Engineer Surveyor-in-Chief.



**200. Tensile Strength and Elongation**

The tensile strength should normally be between the limits of 28 and 40 tons per square inch with a difference of not more than 4 tons per square inch in any one forging. The elongation measured on the appropriate standard test piece C, D or E, should not be less than 17 per cent. for 40 ton steel and in no case should the sum of the tensile strength and the corresponding elongation be less than 57.

**201. Bend Tests**

The bend test pieces should withstand without fracture being bent cold through an angle of 180°, the internal radius of the bend being not greater than that given below:

Specified tensile strength of forging	Internal radius of piece after bending
Up to 32 tons per square inch	$\frac{3}{8}$ inch
Above 32 tons and up to 36 tons per square inch	$\frac{1}{2}$ inch
Above 36 tons and up to 40 tons per square inch	$\frac{5}{8}$ inch

**STEEL CASTINGS**

**202. Heat Treatment**

All steel castings should be suitably heat-treated before the test pieces are selected.

**203. Number and Nature of Tests**

(a) In the case of steel castings for:

- (i) valve chests, branch pieces and fittings less than 4 inches bore;
- (ii) valve chests, branch pieces and fittings 4 inches bore and over subjected to steam pressures not exceeding 150 lb. per square inch or steam temperatures not exceeding 425°F.;
- (iii) ship side valve chests and associated branch pieces and fittings of any size in connection with main or auxiliary machinery or boilers;

it will not be necessary for tensile or bend tests of the material to be witnessed by the Surveyors. Such steel castings may be accepted providing the maker gives a guarantee indicating their physical properties, and providing the castings are inspected and hammer tested to the satisfaction of the Surveyor. The instructions regarding hydraulic tests should however be applied. (See paragraph 247).

(b) All other important steel castings should be tested as follows:

- (i) At least one tensile and one bend test should be made from the castings from each charge; where a casting is made from more than one charge, at least four tensile and four bend tests should be made from pieces cast as far apart as possible on the castings and as near the top and the bottom respectively as practicable.
- (ii) Where more than one casting is made from one charge, at least one tensile and one bend test should be made from the castings run from one common pouring head; separate tests should be made from each casting or set of castings run from each separate pouring head. Small castings may, however, be dealt with in accordance with the provisions of paragraph 179(d).

**204. Tensile Strength and Elongation**

The tensile strength may range from 26 to 35 tons per square inch, with an elongation, measured on standard test piece C, D, or E, of not less than 20 per cent.

The tensile strength of cast steel intended for the more important parts, e.g. webs for crankshafts, boiler mountings, boiler and superheater headers and turbine casings, should be between 28 and 35 tons per square inch with a minimum elongation of 20 per cent. measured on the test piece C, D or E.

For the webs of crankshafts the sum of the tensile strength and percentage elongation should not be less than 57.

**205. Bend Tests**

The bend test pieces should withstand being bent cold, without fracture, through an angle of 120°. The internal radius of the bend in each case should not be greater than one inch.

**STEEL PRESSURE PIPES**

**206. Process of Manufacture**

All pipes subject to internal pressure should be seamless or of lap welded construction (except when other types of construction are submitted to and accepted by the Engineer Surveyor-in-Chief) and made of steel produced by the open hearth or an electric process.

**207. Seamless Steel Pipes**

Tensile tests should be taken from tubes made from each charge as shown in the following table:

Outside diameter of tube	Number of tensile tests
Up to and including 4 inches	1 in 40 or part thereof
Above 4 inches and including 5 inches	1 in 10 or part thereof
Above 5 inches and including 7 inches	1 in 6 or part thereof
Above 7 inches	1 in 4 or part thereof

The tensile strength should be between the limits of 23 and 30 tons per square inch, and the elongation should not be less than 20 per cent. in a length of 8 inches, or 18 per cent. if the thickness of the tubes is less than  $\frac{1}{4}$  of an inch.

**208. Lap Welded Steel Pipes**

Tensile tests should be made from the plates from which the tubes are made. The tensile strength of the material should be between the limits of 22 and 28 tons per square inch, with an elongation of 25 per cent. on a length of 8 inches for material  $\frac{3}{8}$  inch in thickness and upwards. The elongation of material under  $\frac{3}{8}$  inch in thickness may be 3 per cent. less than 25 per cent. for each one-eighth of an inch below  $\frac{3}{8}$  inch in the thickness.

To ensure that the process of welding is satisfactory the scrap ends, or two rings cut from the scrap ends of each tube welded, should be closed in to one-half the internal diameter of the pipe without fracture of the weld when on the major and minor axis of the closed-in rings respectively. When considered necessary, check tensile tests should be made; the tensile strength across the weld should not be less than 20 tons per square inch.

## STEEL AIR BOTTLES

### 209. *Seamless Air Bottles*

The material should be tested in transverse direction and one tensile and one cold bend test should be made from each tube.

The transverse tensile strength of the material should ordinarily be between the limits of 26 and 36 tons per square inch. The elongation measured on a length of 8 inches should not be less than 18 per cent. or 21 per cent. on 5 inches.

The bend test piece should withstand, without fracture, being bent cold through an angle of 180° over an internal radius of  $1\frac{1}{2}$  times the thickness of the test piece.

The test pieces may be straightened hot and subsequently heat treated with the tube; they may be machined to a uniform thickness.

## BRONZE SHAFTING AND CASTINGS

### 210. *Bronze Shafting*

The tensile strength should not be less than 28 tons per square inch and the sum of the tensile strength and corresponding elongation should not be less than 57. Bend test pieces should withstand without fracture, being bent cold through an angle of 120°.

### 211. *Bronze Propellers and Propeller Blades*

The following requirements apply only to propellers for ships of Class I.

At least one tensile test is to be made from each casting.

The tensile breaking strength determined from a standard test piece should be not less than 28 tons per square inch, the percentage elongation should be not less than 15 measured on the test piece C, D or E and the sum of the tensile breaking strength and the percentage elongation should not be less than 48.

### 212. *Castings*

Generally tests need not be made from bronze or gunmetal castings, but in the case of important castings the Surveyor should satisfy himself, if necessary by reference to British Standard 1400:1948, that the composition of the material is suitable for its intended purpose.

Bronze or gunmetal should not be used where the working temperature exceeds 425°F

## REPORTING TESTS RESULTS

213. (a) The Surveyor should submit to the Engineer Surveyor-in-Chief on forms Surveys 24 the results of the tests of material used for the following:

- (i) Shells of boilers including butt straps.
- (ii) Turbine gearing.
- (iii) Material in respect of which the ordinary requirements have not been complied with or concerning which special instructions are required, or where special tensile limits are imposed.
- (iv) Material for which certified copies of the results of the tests are required (see Appendix V).

(b) In all other cases the Surveyor should submit the forms Surveys 24 showing the results of the tests to the Senior Engineer Surveyor, who, if satisfied that the Ministry's requirements have been met will mark the forms with the words "Examined and approved" adding his signature and date.



## Chapter 3

### BOILERS

#### 214. General

(a) All steel used in the construction of boilers must be tested and must comply with the requirements laid down in these instructions.

(b) All steel plates which are welded, flanged, dished or locally heated should, in general, be appropriately heat treated.

(c) Butt straps should be cut from plates and not from rolled strip.

(d) The edges of plates intended for boilers and pressure vessels should be machined or flame cut by machine. Where the carbon content of plates which are to be flame cut exceeds 0.26 per cent. the edges should be ground or machined. All plate edges should have a smooth finish.

(e) All rivet holes should be drilled "fair" and, wherever possible, they should be drilled in place. After the plates have been drilled the burrs should be removed, the faying surfaces of the plates cleaned and the sharp outer edges of holes removed.

(f) The end plates in the steam spaces in way of uptakes should be shielded from contact with hot gases, and the lower riveted joint of the fire-box of vertical boilers should, where necessary, be suitably protected against impingement of the flames.

(g) For water tube boilers and their integral superheaters and economisers see paragraphs 242 to 252.

(h) The term working pressure, W.P., or maximum working pressure, M.W.P., for boilers including integral superheaters referred to throughout Chapters 2-6 and 15 should, unless otherwise defined, be taken to mean the maximum pressure which the boiler is designed to withstand. In the case of safety valves attached to the shells of cylindrical boilers or to the steam drums of water tube boilers this working pressure will usually be the pressure at which these safety valves are set but if the safety valves are set at some lower pressure the working pressure is to be taken as the maximum pressure which the boiler is designed to withstand. In the case of a superheater which is integral with the boiler and where the superheater safety valve is usually set to an appreciably lower pressure than the designed working pressure of the steam drum the working pressure of the boiler as a whole is to be taken as the maximum pressure which the boiler is designed to withstand. The superheater outlet steam pressure will ordinarily be limited by the setting of the superheater safety valve which should be such that the designed working pressure will not be exceeded in any part of the boiler and in no case should the superheater safety valve setting be in excess of the pressure for which the steam pipes and machinery have been designed.

The Factor of Safety should in no case be less than 4.

#### 215. Means for Examination and Cleaning

All boilers should have, where possible, means of access for the examination and cleaning of the inner surfaces of plates and tubes. Where boilers are too small to permit of this, there should be handholes and sightholes sufficiently large and numerous to enable the inside to be cleaned satisfactorily.

Vertical boilers having cross tubes should have a sighthole in the shell opposite one end of each tube sufficiently large to enable the cross tube to be examined and cleaned. The doors of these sightholes should be in positions accessible for that purpose.

**216. Maximum Pitch of Rivets in Longitudinal Joints**

The maximum pitch of the rivets in the longitudinal joints of boiler shells should be:

Maximum pitch in inches =  $C \times T + 1\frac{1}{2}$  inches, where T is the thickness of the plate in inches and C is a coefficient as given in the following table:

Number of Rivets per Pitch	Coefficients for Lap Joints	Coefficients for Double Butt-strapped Joints
1	1.31	1.75
2	2.62	3.50
3	3.47	4.63
4	4.14	5.52
5	—	6.00

**217. Types and Formulae for Riveted Joints**

See sketches on page 78, where

- p = pitch of rivets at outer rows in inches,
- d = diameter of rivet holes in inches,
- a = cross sectional area of one rivet hole in square inches,
- n = number of rivets which are fitted in the pitch p,
- T = thickness of plate in inches,
- C = 1.0 for rivets in single shear as in lap joints, and 1.875 for rivets in double shear as in double butt-strapped joints,
- S = minimum tensile strength of plates in tons per square inch,
- S<sub>1</sub> = shearing strength of rivets, which is taken generally to be 23 tons per square inch, and may be 85 per cent. of the minimum tensile strength of the rivet bars.

**218. Thickness of Riveted Butt Straps**

The outer butt strap of a longitudinal joint should be of sufficient thickness to permit of efficient caulking, and it should have an effective strength not less than  $\frac{1}{2}$  of that required for the shell plate.

Where the number of rivets at the edges of the shell plate is double the number at the edges of the butt straps, then:

$$T_b = \frac{5}{8} \times \frac{(p - d)}{(p - 2d)} \times T$$

- Where T = thickness of shell plates in inches,
- T<sub>b</sub> = thickness of outer butt straps in inches.
- p = pitch of rivets in outer rows at edges of butt straps in inches,
- d = diameter of rivet holes in inches.

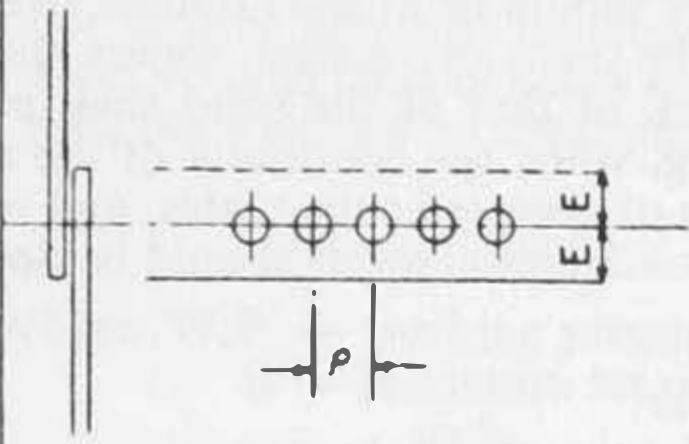
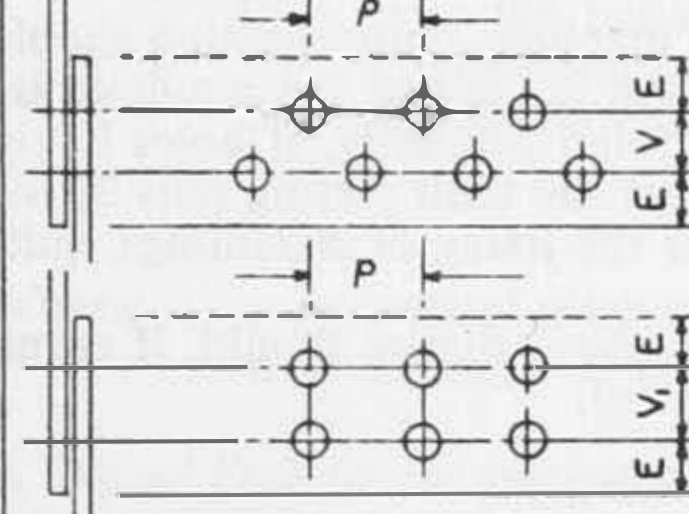
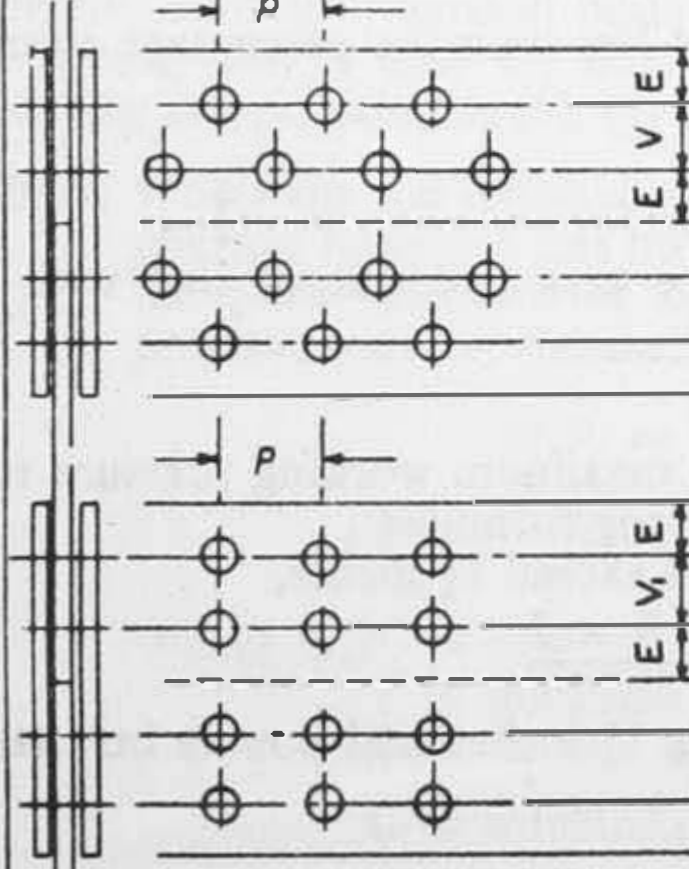
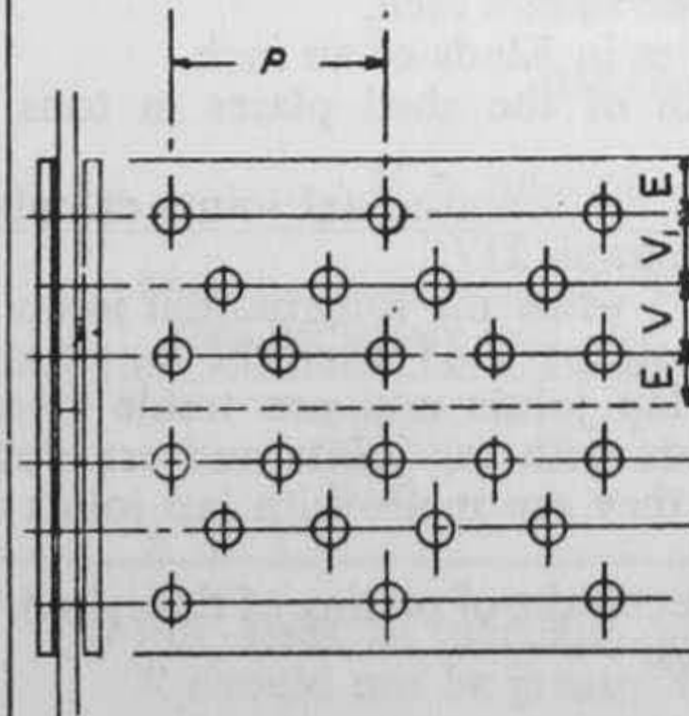
The inner butt strap should be  $\frac{1}{8}$  inch thicker than the thickness required for the outer butt strap.

**219. Circumferential Joints**

(a) The strength of the riveted joints joining the end plates to the cylindrical shell should be not less than 42 per cent. of that of the solid shell plate. Where the shell plate exceeds  $\frac{1}{2}$  inch in thickness the joints connecting the end plates to the shell plate should be double riveted.

(b) The riveted circumferential joint at or near the middle of the length of single-ended boilers should have a strength of not less than 60 per cent. of that of the solid plate. The inner riveted circumferential joints of double-ended boilers should have a strength of not less than 62 per cent. of that of the solid shell plate. In any case there should be three rows of rivets in circumferential joints where single-ended boilers have shell plates over  $1\frac{1}{2}$  inches in thickness

# TYPES AND FORMULAE FOR RIVETED JOINTS

	<p>Single riveted lap joint</p> <p>Max. pitch = <math>1.31T + 1.625</math> in.</p> <p>Plate % = <math>\frac{100(p-d)}{p}</math></p> <p>Rivet % = <math>\frac{100 \times S_1 \times a}{S \times p \times T}</math></p> <p><math>E = 1.5d</math></p>
	<p>Double riveted lap joint</p> <p>Max. pitch = <math>2.62T + 1.625</math> in.</p> <p>Plate % = <math>\frac{100(p-d)}{p}</math></p> <p>Rivet % = <math>\frac{100 \times S_1 \times a \times n}{S \times p \times T}</math></p> <p><math>E = 1.5d</math></p> <p><math>V = 0.33p + 0.67d</math>     <math>V_1 = 2d</math></p>
	<p>Double butt straps: double riveted</p> <p>Max. pitch = <math>3.5T + 1.625</math> in.</p> <p>Plate % = <math>\frac{100(p-d)}{p}</math></p> <p>Rivet % = <math>\frac{100 \times S_1 \times 1.875 \times a \times n}{S \times p \times T}</math></p> <p><math>E = 1.5d</math></p> <p><math>V = 0.33p + 0.67d</math>     <math>V_1 = 2d</math></p>
	<p>Double butt straps: equal width: treble riveted</p> <p>Max. pitch = <math>6T + 1.625</math> in.</p> <p>Plate % = <math>\frac{100(p-d)}{p}</math></p> <p>Rivet % = <math>\frac{100 \times S_1 \times 1.875 \times a \times n}{S \times p \times T}</math></p> <p>Combined % = <math>\frac{100(p-2d)}{p} + \frac{100 \times S_1 \times a \times 1.875}{S \times p \times T}</math></p> <p><math>E = 1.5d</math></p> <p><math>V = 0.165p + 0.67d</math></p> <p><math>V_1 = 0.2p + 1.15d</math></p>



and where double-ended boilers have shell plates over 1  $\frac{1}{4}$  inches in thickness. Where the shell plates are less than 1  $\frac{1}{4}$  inches in thickness the intermediate circumferential joints of double-ended boilers should be at least double riveted.

(c) The riveted circumferential joints of the shells of vertical boilers should have a strength of not less than 42 per cent. of that of the solid shell plate. When the joints are not complete circles, e.g. when the continuity of the shell longitudinally is interrupted by the insertion of recessed tube plates, and when the plates exceed  $\frac{1}{2}$  inch in thickness, the circumferential joints should be double riveted.

## **220. Manholes and Large Holes in Shell Plates**

(a) Manholes in cylindrical shells should have their shorter axes arranged longitudinally.

(b) Where the cylindrical shell is cut for a manhole, compensation should be provided and should be such that the strength in way of the manhole is not less than that required for the longitudinal joint. Similarly, if holes having a diameter greater than 2  $\frac{1}{2}$  times the thickness of the shell plating plus 2  $\frac{1}{2}$  inches are cut in the cylindrical shells of boilers for the fixing of mountings, suitable compensation should be provided.

(c) The neutral part of boiler shells under steam domes should, if required, be efficiently stayed, or otherwise compensated.

## **221. Spacing of Screw Stays through Cylindrical Shell**

Where more than three screw stays pierce the cylindrical shell in a longitudinal line, the value of  $\frac{100(p - d)}{p}$  should be not less than the percentage strength required for the shell longitudinal joints,

where  $d$  = the diameter in inches,

$p$  = the pitch of the stays in inches.

If this is not possible, the stays should be arranged out of line with one another longitudinally.

## **222. Working Pressure of Boiler Shells**

(a) For riveted steel cylindrical shells the maximum working pressure to be allowed should be calculated from the following formulae:

If the thickness of the shell plates does not exceed 1  $\frac{1}{2}$  inches,

$$\text{W.P.} = \frac{(t - 2) \times S \times J}{C \times D}$$

If the thickness of the shell plates exceeds 1  $\frac{1}{2}$  inches and double butt straps are fitted,

$$\text{W.P.} = \frac{t \times S \times J}{2.85 \times D}$$

Where W.P. = working pressure in lb. per square inch,

$t$  = thickness of the shell plates in 32nds of an inch,

$S$  = minimum tensile strength of the shell plates in tons per square inch,

$J$  = percentage of strength of the longitudinal joints calculated by the methods of paragraph 217,

$C$  = a coefficient, which is 2.75 when the longitudinal joints are made with double butt straps; 2.83 when the longitudinal joints are made with lap joints and are treble riveted; 2.9 when they are made with lap joints and are double riveted, and 3.3 when they are made with lap joints and are single riveted,

$D$  = inside diameter of the outer strake of plating of the cylindrical shell measured in inches.

(b) Where vertical boilers have a nest or nests of horizontal tubes so that there is a direct tension on the tube plates due to the vertical load on the boiler ends or to their acting as horizontal ties across the shell, each alternate tube in the outer vertical rows of tubes should be a stay tube. The working pressure on the tube plate should be determined by the following formula:

$$\text{W.P.} = \frac{(t - 2) \times S \times J}{2.9 \times D}$$

Where W.P. = working pressure in lb. per square inch,

S = minimum tensile strength of the tube plate in tons per square inch,

t = thickness of the tube plate in 32nds of an inch,

D = twice the radial distance of the centre of the outer row of tube holes from the axis of the shell in inches,

J = percentage strength of the plate through the tube holes, viz.:

$$\frac{100(p - d)}{p}$$

Where p = vertical pitch of tubes in inches,

d = diameter of the tube holes in inches.

### 223. Dished Ends (convex outside)

(a) The working pressure on the unstayed dished ends of boiler drums, steam receivers, crowns of vertical boilers, etc., where the working temperature does not exceed 650°F. may be obtained from the appropriate formulae in the following sub-paragraphs (b), (c) or (d).

(b) (i) Where the end is dished to partially spherical, semi-ellipsoidal or hemispherical form and has no unreinforced opening greater than four times the plate thickness or  $2\frac{1}{2}$  inches whichever is the less, the working pressure may be obtained from the following formula:

$$\text{W.P.} = \frac{(T - 0.1) \times 2 \times F}{D \times C}$$

$$\text{i.e. } T = \frac{\text{W.P.} \times D \times C}{2 \times F} + 0.1$$

Where W.P. = working pressure in lb. per square inch,

T = thickness of end in inches,

D = outside diameter of the end in inches,

C = a factor, dependent upon the ratio  $\frac{h}{D}$  where h is the

external height, and generally obtained from the curve (see Fig. 2). In no case should C be taken as

less than  $1.15 \frac{R}{D}$  or  $0.12 \frac{D}{r}$

F = nominal stress in lb. per square inch as follows:

Ultimate tensile strength tons per square inch	Nominal stress (F) lb. per square inch
24/28	13,400
26/30	14,500
28/32	15,700

(ii) For ends of partially spherical form, the inside radius of dishing R should not be greater than the diameter D.

- (iii) Wherever practicable, the inside corner radius should not be less than 12.5 per cent. of the inside diameter, but if this is impracticable it should be not less than 6 per cent. of the inside diameter.
- (iv) For ends of semi-ellipsoidal form the ratio of the major axis to the minor axis should be not greater than 2.
- (v) For ends having a central flanged manhole or handhole complying with sub-paragraph (vi),  $T$  as obtained from the formula in sub-paragraph (i) should be increased by at least 15%, but in no case by less than  $\frac{1}{8}$  inch.
- (vi) The depth  $G$  (see Fig. 1) of the manhole flange, measured at the minor axis should be not less than

$$\sqrt{T_B \times w}$$

Where  $T_B$  = required thickness of pierced dished end plate in inches,  
 $w$  = minor axis of the manhole in inches.

The corner radius of the manhole flange  $r_m$  (see Fig. 1) should be not less than 1 inch.

- (vii) For ends having unreinforced holes of greater dimensions than allowed in sub-paragraph (i) and not conforming to the requirements of sub-paragraph (v), the thickness  $T$  obtained by the formula in sub-paragraph (i) should be increased by more than 15% dependent upon the size, shape and position of the hole. Ends with large unreinforced holes, or with eccentric flanged manholes or handholes should be avoided wherever practicable.
- (viii) The thickness  $T$  specified in sub-paragraphs (i), (v) and (vii), is the thickness of the end after manufacture and is applicable over the whole area of the end up to the point where, for ends of partially spherical shape, the dishing radius joins the corner radius; from this point a gradual thinning is permissible up to a maximum of 10 per cent. of the thickness  $T$  at the point where the corner radius joins the straight portion of the flanged end. A similar gradual thinning is permissible for ends of semi-ellipsoidal shape. This permissible reduction in thickness also applies to the flange for the manhole opening.
- (ix) For ends which are butt welded to the drum shell, the thickness of the edge of the flange for connection to the shell should be not less than the required thickness of the unpierced shell. See (x) NOTE 3.
- (x) NOTE 1. The external height of dishing 'h' may, for ends of partially spherical form, be determined as follows (see Fig. 1).

$$h = R_2 - \sqrt{\left(R_2 - \frac{D}{2}\right) \times \left(R_2 + \frac{D}{2} - 2r_2\right)}$$

NOTE 2. Where the above rules are applied to small drum ends with manhole openings, the dimensions 'r' and ' $r_m$ ' (see Fig. 1) apply only to the section of the end containing the minor axis of the opening, i.e. 'r' and ' $r_m$ ' need not apply throughout the whole periphery of such ends.

NOTE 3. The limitation of the flange edge thickness may, for deep ends with low values of  $C$ , and particularly for hemispherical ends, actually determine the end thickness  $T$  and overrule the thickness  $T$  resulting from the formula in sub-paragraph (i).



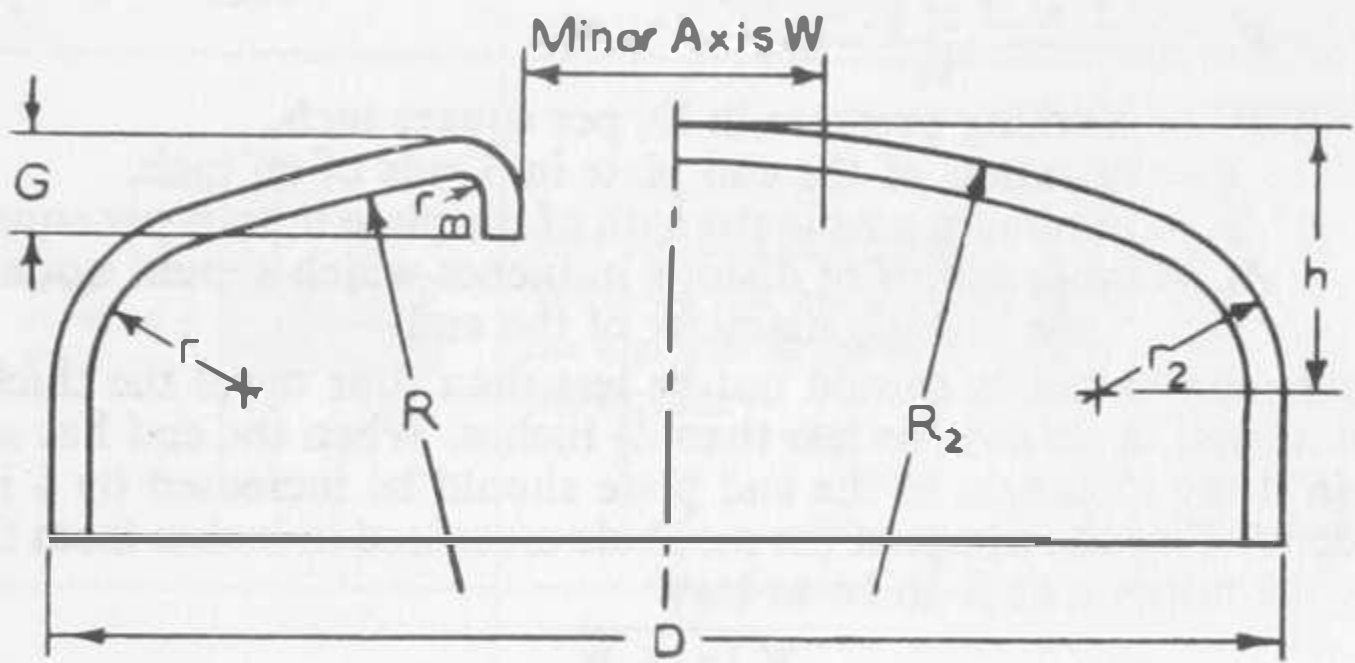


Fig.1.

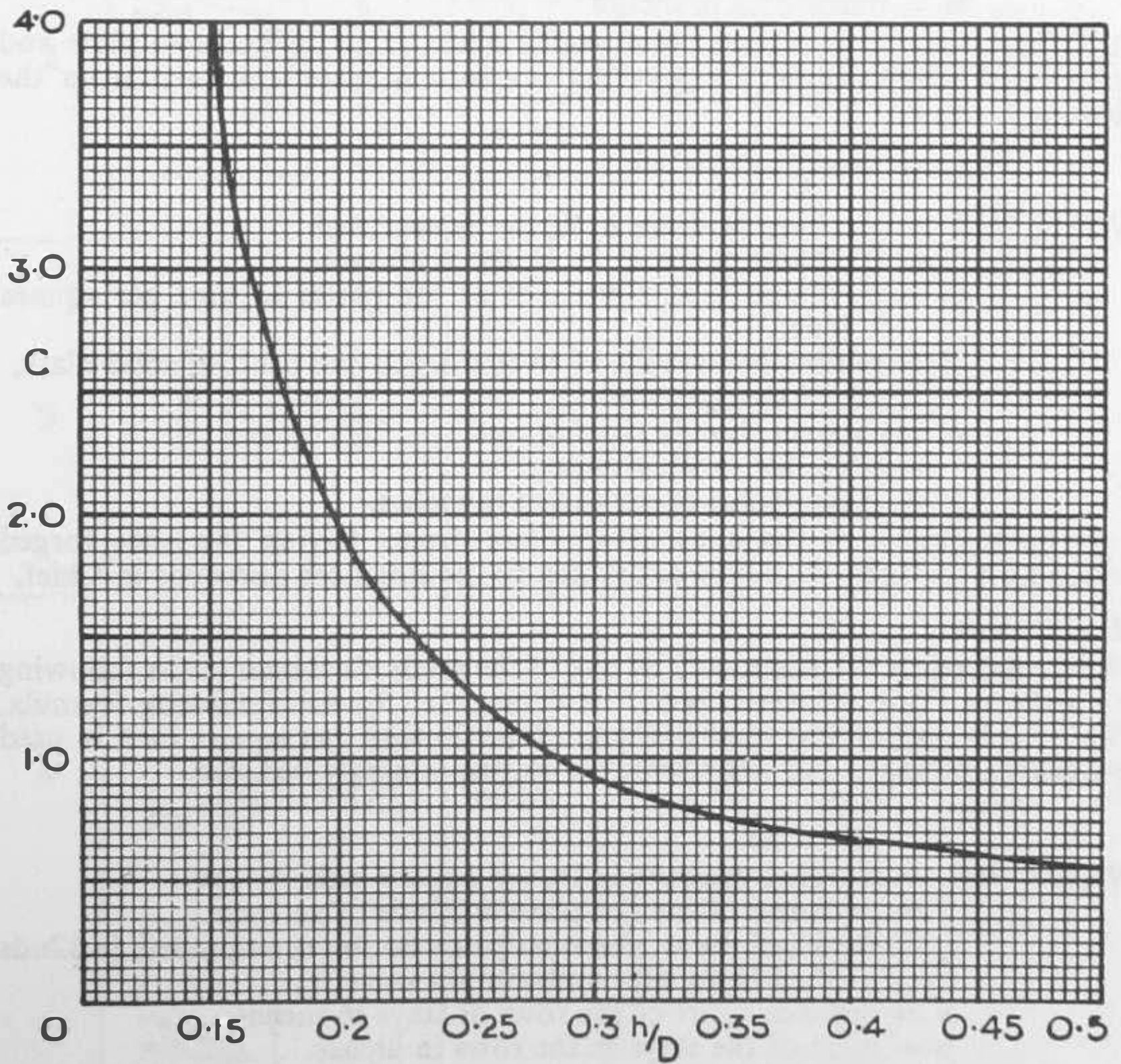


Fig.2.

(c) Where the end is dished to partially spherical form having no unreinforced opening greater than four times the plate thickness or  $2\frac{1}{2}$  inches whichever is the less, the working pressure may be obtained from the following formula:

$$W.P. = \frac{15 \times S \times (t - 1)}{R}$$

Where W.P. = working pressure in lb. per square inch,  
 $t$  = thickness of the end plate in 32nds of an inch,  
 $S$  = minimum tensile strength of the plate in tons per square inch,  
 $R$  = inner radius of dishing in inches which should not exceed  $D$  the outside diameter of the end.

The inside corner radius should not be less than four times the thickness of the end plate and in no case be less than  $2\frac{1}{2}$  inches. When the end has a flanged manhole in it the thickness of the end plate should be increased by  $\frac{1}{4}$  inch and the total depth  $G$  of the flange of the manhole measured in inches from the outer surface at the minor axis is to be at least

$$\sqrt{T_R \times w}$$

Where  $T_R$  = required thickness of the pierced dished end plate in inches,  
 $w$  = minor axis in inches

(d) Where the end is a hemisphere and is made in more than one plate and is of riveted construction, the working pressure may be obtained from the following formula:

$$W.P. = \frac{(t - 2) \times S \times J}{C \times R}$$

Where W.P. = working pressure in lb. per square inch,  
 $t$  = thickness of plates in 32nds of an inch,  
 $S$  = minimum tensile strength of the plates in tons per square inch,  
 $J$  = minimum strength of riveted joints per cent. of solid plate,  
 $C = \begin{cases} 3.3 & \text{for single riveting,} \\ 2.9 & \text{for double riveting,} \\ 2.83 & \text{for treble riveting,} \end{cases}$   
 $R$  = inner radius of curvature in inches.

(e) The thickness of the ends of seamless drums having the ends forged integral with the shell should be submitted to the Engineer Surveyor-in-Chief.

#### 224. Flat Plates

Where flat plates are supported by one of the methods shown in the following figures the working pressure should be determined by the following formula, except that if steel of less tensile strength than 26 tons per square inch is used the working pressure allowed should be correspondingly reduced:

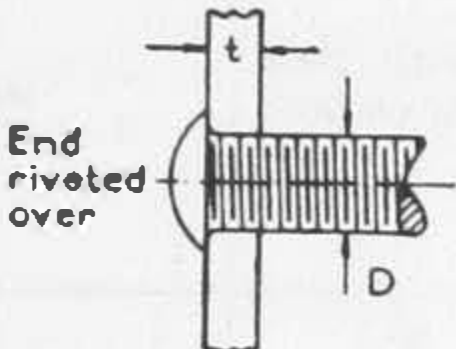
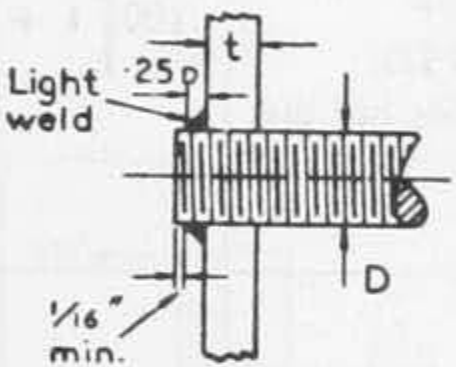
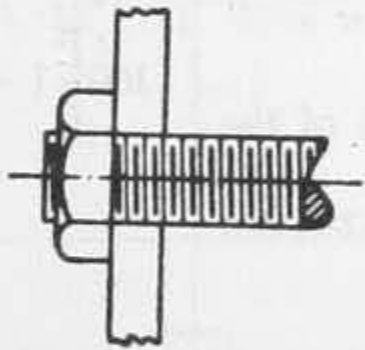
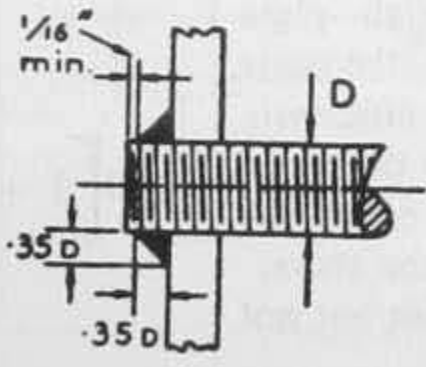
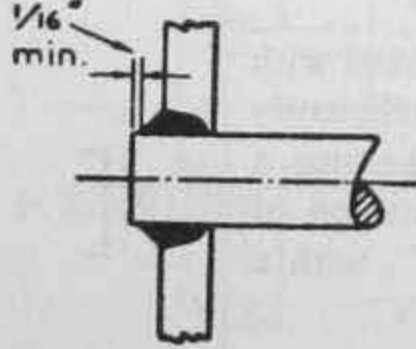
$$W.P. = \frac{C (t - 1)^2}{a^2 + b^2}$$

Where W.P. = working pressure in lb. per square inch,  
 $t$  = thickness of the flat plate in 32nds of an inch,  
 $t_w$  thickness of the washers, strips or doubling employed, in 32nds of an inch, with a maximum value 't',  
 $a$  = distance apart of the rows of stays in inches,  
 $b$  = pitch of the stays in the rows in inches.

NOTE. Where the stays are irregularly pitched 'd<sup>2</sup>' is to be taken instead of  $a^2 + b^2$ , where 'd' is the diameter of the largest circle which can be drawn through any three points of support without enclosing another point of support.

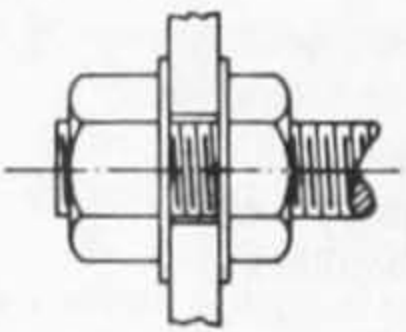
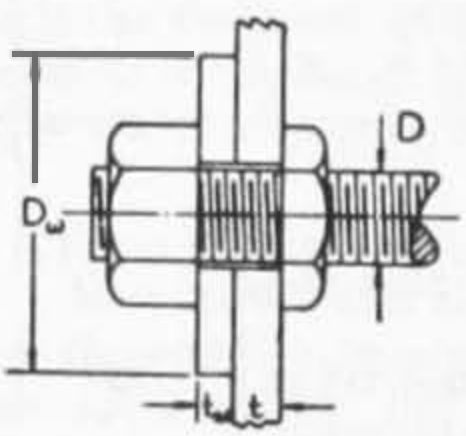
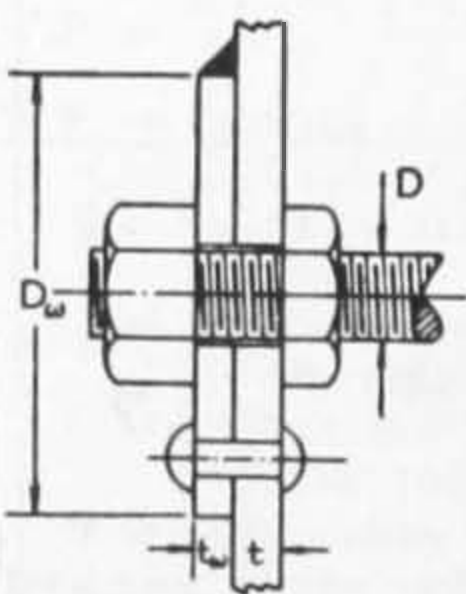
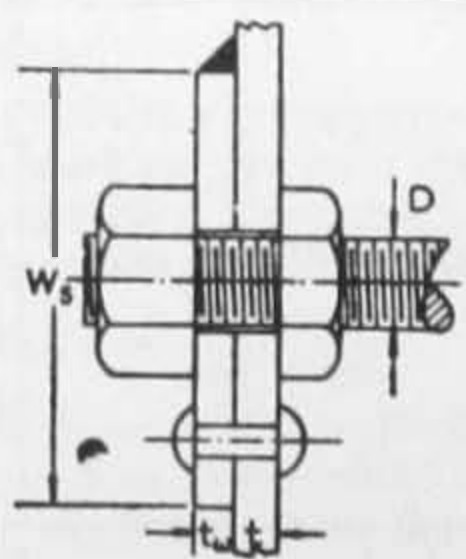
$C$  = a coefficient which varies with the method of supporting the plate. Typical methods and values are shown in the following figures:

# TYPICAL METHODS OF ATTACHING STAYS

Figure No.	Type	Description	C Exposed to Flame	C Not Exposed to Flame
1	 <p>End riveted over</p>	Stay screwed into plate. "t" to be not less than 0.5 of the diameter at the bottom of the thread.	50	57
2	 <p>Light weld 0.25D 1/16" min.</p>	Stay screwed into plate and welded. "t" to be not less than 0.5 of the diameter at the bottom of the thread.	50	57
3		Stay screwed into plate and fitted with nut.	75	86
4	 <p>1/16" min. 0.35D 0.35D</p>	Stay screwed into plate and welded.	75	86
5	 <p>1/16" min.</p>	Stay passing through plate and welded.	75	86

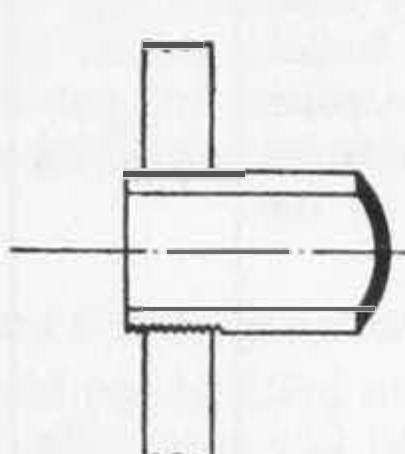
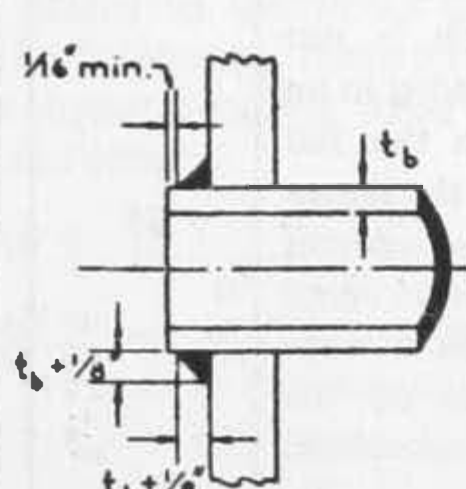
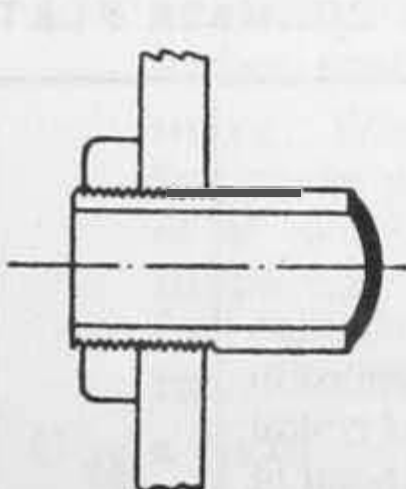
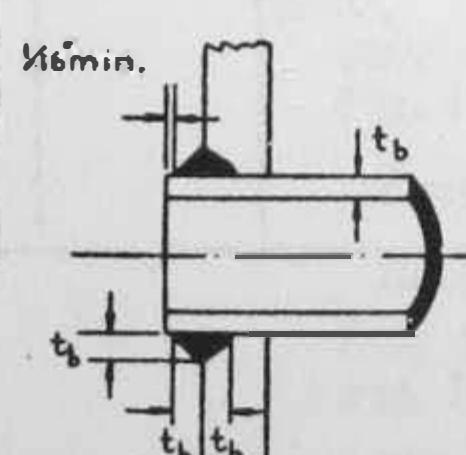


# TYPICAL METHODS OF ATTACHING STAYS

Figure No.	Type	Description	C Not Exposed to Flame
6		Stay passing through plate and fitted with nuts on both sides of the plate.	96
7		Stay passing through plate and fitted with nuts and a large circular washer. $D_w$ being at least $3.5D$ . $t_w$ being at least $.66t$ but not more than $"t"$ .	$100 \left[ 1 + \frac{.15t_w^2}{(t-1)^2} \right]$
8		Stay passing through plate and fitted with nuts and a large circular washer, the washer being riveted or welded to the plate. $D_w$ being at least $.66$ of the mean pitch. $t_w$ being at least $.66t$ but not more than $"t"$ .	$100 \left[ 1 + \frac{.35t_w^2}{(t-1)^2} \right]$
9		Stay passing through plate and fitted with nuts, the plate stiffened by a strip efficiently riveted or welded to the plate. $W_s$ being at least $.66$ of the mean pitch of the stays. $t_w$ being at least $.66t$ but not more than $"t"$ .	$100 \left[ 1 + \frac{.55t_w^2}{(t-1)^2} \right]$
10		Where the plate is fitted with a doubling plate efficiently secured to it and having a thickness, $t_w$ , at least $.66$ of that of the plate, $"t"$ , with a maximum value of $"t"$ .	$100 \left[ 1 + \frac{.85t_w^2}{(t-1)^2} \right]$

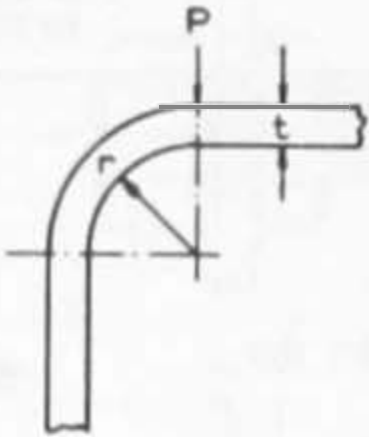
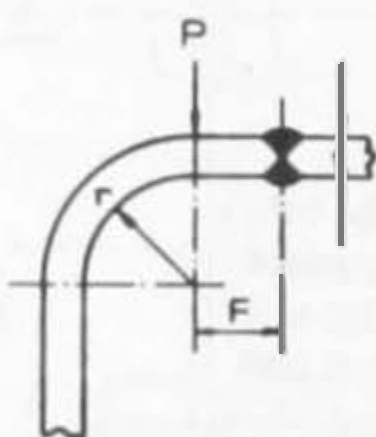
## TYPICAL METHODS OF ATTACHING STAY TUBES

For the values of "C" for the back and front tube plates and the wide water spaces of the tube plates between the nests of tubes and between the wing rows of tubes and the shell see Paragraph 225.

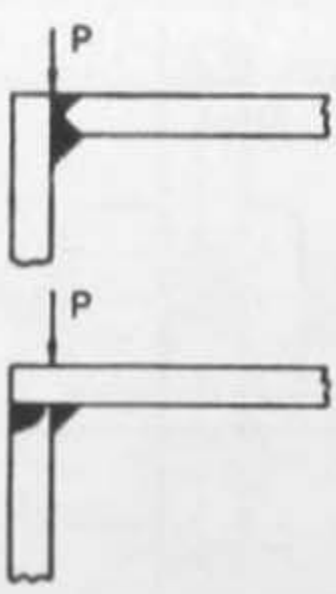
Figure No.	Type	Description	C Not Exposed to Flame
11		Stay tube screwed into the plate and expanded.	52
12		Stay tube welded to the tube plate, tube to be expanded into the tube plate before and after welding, see note at end of Paragraph 225.	52
13		Stay tube screwed into the plate, expanded, and fitted with nut.	72
14		Stay tube welded to the tube plate, tube to be expanded into the tube plate before and after welding see note at end of Paragraph 225.	72

FLAT PLATES

FLANGED AND WELDED

Figure No.	Type	Description	C Exposed to Flame	C Not Exposed to Flame
15	 <p>P = Point of Support</p>	Plate with flange the inner radius (r) of which is not greater than $2\frac{1}{2}t$ . The point of support is to be taken on the commencement of the curvature.	96	110
16	 <p>P = Point of Support</p>	Plate with flange the inner radius (r) of which is not greater than $2\frac{1}{2}t$ , welded in an efficient manner to the flat plate. The depth of the flange (F) from the commencement of curvature to the weld being at least $3t$ , the point of support may be taken on the commencement of curvature.	85	100

TYPICAL FLAT WELDED COMBUSTION CHAMBER PLATES

17	 <p>P = Point of Support</p>	Where the flat combustion chamber plates are welded in an efficient manner, as typical examples shown, the point of support should be taken in line with the surface of the supporting plate.	80	
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Where a portion of a plate is supported by different methods, the value of  $C$  will be the mean of the values appropriate to the methods of support.

For the tops and sides of combustion chambers the distance between the rows of stays nearest to the back tube plate or to the back plate and the commencement of curvature of these plates at their flanges should not be greater than 'a'. Where the tops of combustion chambers are joined to the sides by curved portions, if the outer radius of the curved portion is less than half the allowable distance between the girders, the distance between the first girder and the inner surface of the side plate should not exceed the allowable distance between the girders. If the radius of the curved portion is greater than half the allowable distance between the girders, the width of the flat portion measured from the centre of the girder should not be more than half the allowable distance between the girders.

## 225. Back and Front Tube Plates

Nuts should not be fitted to stay tubes at the combustion chamber end; if any are fitted no allowance will be given in respect of them.

For the wide water spaces of the tube plates between the nests of tubes and between the wing rows of tubes and the shell and for the portions of back and front tube plates in the nests of tubes, the working pressure should be determined by the following formula except that if steel of less tensile strength than 26 tons per square inch is used the working pressure allowed should be correspondingly reduced:

$$W.P. = \frac{C(t - 1)^2}{a^2 + b^2}$$

Where W.P. = working pressure in lb. per square inch,

$t$  = thickness of the tube plate in 32nds of an inch,

$t_w$  = thickness of the riveted doubling plate when fitted, in 32nds of an inch with a maximum value 't',

$a$  = horizontal pitch of the stay tubes in inches measured across the wide water spaces from centre to centre,

$b$  = vertical pitch of the stay tubes in the bounding rows in inches, centre to centre.

NOTE. When considering the portions of the back and front tube plates in the nests of tubes  $p^2$  is to be taken instead of  $a^2 + b^2$  where 'p' is the mean pitch of the stay tubes supporting any portion of the plate, being the sum of the four sides of any quadrilateral formed by four adjacent stays, divided by four.

$C$  = a coefficient which varies with the method of securing the stay tube as follows:

(i) For the wide water spaces between and around the tube nests,

Stay tubes secured to the tube plate as shown in Fig. 11 or 12,

$$\text{Front tube plate } C = 52 \left[ 1 + \frac{.55t_w^2}{(t - 1)^2} \right]$$

$$\text{Back tube plate } C = 45.$$

Stay tubes secured to the tube plate as shown in Fig. 13 or 14,

$$\text{Front tube plate } C = 72 \left[ 1 + \frac{.55t_w^2}{(t - 1)^2} \right]$$

$$\text{Back tube plate } C = 45.$$

Stay tubes secured to the tube plate as shown in Fig. 15 or 16 with alternate stay tubes secured as shown in Fig. 13 or 14,

$$\text{Front tube plate } C = 63 \left[ 1 + \frac{.55t_w^2}{(t-1)^2} \right]$$

$$\text{Back tube plate } C = 45.$$

(ii) For portions of the back and front tube plates in the nests of tubes,

Stay tubes secured to the tube plates as shown in Fig. 11 or 12,

$$C = 38.$$

Stay tubes secured to the front tube plate as shown in Fig. 13 or 14,

$$C = 49.$$

NOTE. Where stay tubes are attached by welding and where the weld is not suitably stress relieved they should not be adjacent within the same tube nest except in small local areas.

## 226. Manholes and Handholes in Flat Plates

When a flat plate is flanged to stiffen it at a manhole or handhole, to permit the same working pressure as would be allowed upon an unpierced plate, the depth of the flange measured from the outer surface should be at least equal to:

$$\sqrt{T \times w}$$

Where  $T$  = thickness of the plate in inches,  
 $w$  = minor axis of the hole in inches.

## 227. Plain Furnaces

(a) The working pressure allowed on plain furnaces or furnaces strengthened by Adamson or other joints, and on the cylindrical bottoms of combustion chambers should be determined by the following formulae, the lower pressure obtained being allowed:

$$\text{W.P.} = \frac{C(t-1)^2}{(L+24) \times D}$$

$$\text{W.P.} = \frac{C_1}{D} \times [10(t-1) - L]$$

Where W.P. = working pressure in lb. per square inch,  
 $D$  = external diameter of the furnace or combustion chamber bottom in inches,  
 $t$  = thickness of the furnace plate in 32nds of an inch,  
 $L$  = length, in inches of the furnace or combustion chamber bottom between points of substantial support, measured from the centres of rivet rows or from the commencement of flange curvature, whichever is applicable,  
 $C$  = 1450 where the longitudinal seams are welded and 1300 where they are riveted,  
 $C_1$  = 50 where the longitudinal seams are welded and 45 where they are riveted.

(b) When plain vertical furnaces are tapered, the diameter to be taken for calculation purposes should be the mean of that at the top and at the bottom where the furnace meets the substantial support from flange or ring. The length for the same purpose should be the distance from the centre of the row of rivets connecting the crown to the body of the furnace, to the substantial support at the bottom of the furnace, or to a row of stays connecting the furnace to the

shell, provided the pitch of stays at the furnace does not exceed 14 times the thickness of the furnace plate when the stays are riveted at their ends, and 16 times when they are fitted with nuts or strength welded. Such stays should be, in diameter over the threads, not less than 2.25 times the thickness of the furnace plate.

### 228. *Corrugated Furnaces*

The working pressure to be allowed on corrugated furnaces is to be determined by the following formula:

$$W.P. = \frac{C (t - 1)}{D}$$

Where W.P. = working pressure in lb. per square inch,

D = external diameter in inches measured at the bottom of the corrugations,

t = thickness of the furnace plate in 32nds of an inch, measured at the bottom of the corrugation or camber,

C = 480 for the Fox, Morison, Deighton, and similar furnaces, and 510 for the Suspension Bulb furnace.

The shape and dimensions of corrugated furnaces of the usual types should be in accordance with the British Standard No. 1971:1953.

### 229. *Spherical Furnaces*

When the furnaces are spherical in form and convex upwards at their tops, and are without support from stays of any kind,

$$W.P. = \frac{275 (t - 1)}{R}$$

Where W.P. = working pressure in lb. per square inch,

t = thickness of the top plate in 32nds of an inch,

R = outer radius of curvature of the furnace in inches.

### 230. *Maximum Thickness of Furnaces*

No furnace, plain or corrugated, should exceed  $\frac{7}{8}$  inch in thickness.

### 231. *Ogee Ring*

For the ogee ring, which connects the bottom of the furnace to the shell, and sustains the whole load on the furnace vertically,

$$W.P. = \frac{140 (t - 1)^2}{D \times (D - d)}$$

Where W.P. = working pressure in lb. per square inch,

t = thickness of the ogee ring in 32nds of an inch,

D = inside diameter of the boiler shell in inches,

d = outside diameter, in inches, of the lower part of the furnace where it joins the ogee ring.

### 232. *Internal Uptakes of Vertical Boilers*

The working pressure allowed on internal uptakes of vertical boilers should be determined by the following formulae, the lower pressure obtained being allowed:

$$W.P. = \frac{C (t - 5)^2}{(L + 24) \times D}$$

$$W.P. = \frac{C_1}{D} \times [10 (t - 5) - L]$$

Where W.P. = working pressure in lb. per square inch,

D = external diameter of the uptake in inches,

t = thickness of the uptake in 32nds of an inch,



$L$  = length, in inches, of the uptake between points of substantial support, measured from the centres of rivet rows,  
 $C$  = 1450 where the longitudinal seams are welded and 1300 where they are riveted,  
 $C_1$  = 50 where the longitudinal seams are welded and 45 where they are riveted.

### 233. Compression on Tube Plates

The working pressure on back tube plates between the tubes is obtained from the formula:

$$W.P. = \frac{875 \times (D - d) \times t}{W \times D}$$

Where  $W.P.$  = working pressure in lb. per square inch,  
 $t$  = thickness of the tube plates in 32nds of an inch,  
 $D$  = horizontal distance apart of the tubes, centre to centre, in inches,  
 $d$  = internal diameter in inches of the plain tubes,  
 $W$  = width in inches of combustion chamber measured inside from tube plate to back chamber plate, or between tube plates in double-ended boilers with combustion chambers common to two opposite furnaces.

### 234. Steel Stays

Steel stays are not to be welded within their length. If stays are heated for upsetting or any other purpose they should be subsequently annealed.

### 235. Steel Longitudinal Stays

(a) Screwed longitudinal stays should have threads in accordance with the appropriate British Standard. Stays 2 inches in diameter and above passing through plates and secured by nuts on each side of the plate should have not more than 6 threads per inch.

(b) The working pressure allowed in respect of the screwed portion of longitudinal stays with threads not coarser than 6 threads per inch is obtained from the following formula, but in no case should the stress exceed 11,000 lb. per square inch when steel of a minimum tensile strength of 28 tons per square inch is used:

$$W.P. = \frac{(d - 0.340)^2 \times 9500}{a} \times \frac{S}{28}$$

The working pressure allowed in respect of the unscrewed portion of all longitudinal stays, and on the screwed portion when the threads are coarser than 6 threads per inch, is obtained from the following formula but in no case should the stress exceed 11,000 lb. per square inch when steel of a minimum tensile strength of 28 tons per square inch is used:

$$W.P. = \frac{(d_1 - 0.125)^2 \times 9500}{a} \times \frac{S}{28}$$

Where  $W.P.$  = working pressure in lb. per square inch,  
 $d$  = diameter of the stay, in inches, over the thread,  
 $d_1$  = diameter of the stay, in inches, at the bottom of the thread or at the smallest unscrewed part,  
 $a$  = area in square inches supported by the stay,  
 $S$  = minimum tensile strength of the steel in tons per square inch.

(c) Where longitudinal stays are secured by welding the working pressure allowed should be such that the stress in the stay will not exceed 11,000 lb. per square inch when steel of a minimum tensile strength of 28 tons per square inch is used.

(d) In double-ended boilers the through longitudinal stays should be supported at or near the middle of their length.

### 236. Stays in Combustion Chambers

(a) Screw stays should have threads in accordance with the appropriate British Standard. Stays  $1\frac{1}{2}$  inches in diameter and above should have 9 threads per inch.

(b) The working pressure allowed in respect of screw stays with threads not coarser than 9 threads per inch made of steel or special wrought iron which has been tested in accordance with the requirements of paragraph 190 is obtained from the following formula, but in no case should the stress exceed 9,000 lb. per square inch:

$$\text{W.P.} = \frac{(d - 0.267)^2 \times 8250}{a}$$

Where W.P. = working pressure in lb. per square inch,  
d = diameter, in inches, of the stay over the thread,  
a = area in square inches supported by the stay.

(c) Nuts for screw stays in combustion chambers should be of mild steel or iron, without weld. They should be not less than  $\frac{3}{4}$  inch thick for stays up to  $1\frac{1}{2}$  inches diameter over threads,  $\frac{7}{8}$  inch thick for  $1\frac{1}{2}$  and  $1\frac{3}{4}$  inch stays, 1 inch thick for  $1\frac{7}{8}$  and 2 inch stays, and  $1\frac{1}{8}$  inches thick for stays over 2 inches in diameter.

(d) It is desirable that combustion chamber stays when fitted with nuts should be so placed that the seams of the plates can be caulked without removing the nuts. The stays should be normal to the chamber plates, and when this is not possible, they should be fitted with taper washers to provide a fair bed for the nuts.

(e) Where the stays are welded to the plates in a satisfactory manner (see paragraph 224) the maximum stress should not exceed 9,000 lb. per square inch.

(f) Iron screw stays should have a hole about  $\frac{3}{16}$  inch in diameter drilled axially in their outer ends to a distance  $\frac{1}{2}$  inch beyond the inner face of the shell or end plates. It is recommended that steel screw stays should have a similar hole in their outer ends.

### 237. Stay Tubes

(a) On stay tubes, whether of wrought iron or steel, a working stress of 7,500 lb. per square inch of the net sectional area may be allowed.

(b) Screwed stay tubes should be screwed at both ends with continuous threads, and the holes in the tube plates tapped with continuous threads. The threads should not be finer than 10 threads per inch. It is desirable, however, that they should be screwed to the standard 9 threads per inch.

Stay tubes may be strength welded to the tube plates (see paragraph 224).

(c) The minimum thickness of welded stay tubes and of screwed stay tubes measured at the bottom of the thread should be  $\frac{1}{4}$  inch for marginal stay tubes and  $\frac{3}{16}$  inch for other stay tubes. If stay tubes are required to have their thickness increased at the screwed ends so that the thickness at the bottom of the thread is practically the same as in the body of the tube, the thickening should be effected by upsetting and not by any welding process, and the tubes should be annealed after the upsetting.

**238. Girders supporting Combustion Chamber Tops**

For girders supporting the tops of combustion chambers the following formula is to be used:

$$W.P. = \frac{C \times d^2 \times t}{(L - P) \times D \times L} \times \frac{S}{28}$$

- Where W.P. = working pressure in lb. per square inch,  
d = depth of the girder at centre in inches,  
t = effective thickness of the girder at centre in 32nds of an inch,  
L = length, in inches, measured between the tube plate and back chamber plate inside, or between tube plates in chambers common to two opposite furnaces,  
P = pitch of stays supported by the girder in inches,  
D = distance apart of girders, centre to centre in inches,  
S = minimum tensile strength of the steel plates forming the girder, in tons per square inch. In the case of forged girders S is to be taken as 24 for iron and 28 for steel,

$$C = \begin{cases} \frac{n}{n + 1} \times 495 \text{ when } n \text{ is odd,} \\ \frac{n + 1}{n + 2} \times 495 \text{ when } n \text{ is even,} \end{cases}$$

Where n = number of stays in a girder.

Girders attached to combustion chamber plates by welding may be accepted if of equivalent strength.

**239. Plain Smoke Tubes**

The following table may be used to obtain the working pressure allowed on plain iron or steel smoke tubes:

Outside Diameter in inches	Standard Thicknesses in S.W.G.				Working Pressures in lb. per square inch			
Inches	A	B	C	D	A	B	C	D
2	—	11	10	9	—	155	215	300
2½	11	10	9	8	140	190	260	330
2¾	11	10	9	8	125	175	230	300
2½	11	10	9	8	130	160	215	275
3	10	9	8	7	140	190	250	300
3½	10	9	8	7	130	180	230	280
3¾	10	9	8	7	120	165	215	260

**240. Doors**

Doors should be of steel. The doors to manholes, handholes and sight-holes should be built up or pressed to shape and annealed, or made from one thickness of plate with a machined recess for the jointing material. The spigot part or the recess should not have a greater clearance than 1/16 inch all round, i.e. the axes of the doors should not be less than those of the holes in which they are fitted by more than 1/4 inch.

The studs of all doors should be screwed through the plate, and should be fitted with nuts on the inside, or bolts may be used screwed through the plate with the heads inside.

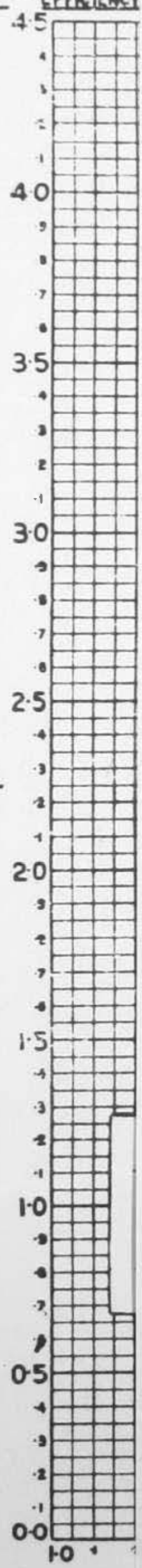
**241. Hydraulic Tests**

For hydraulic tests on boilers see paragraph 247.



E = DIAGONAL  
EFFICIENCY

$\frac{P_c}{d}$



**238. Girders supporting Combustion Chamber Tops**

For girders supporting the tops of combustion chambers the following formula is to be used:

$$W.P. = \frac{C \times d^2 \times t}{(L - P) \times D \times L} \times \frac{S}{28}$$

- Where W.P. = working pressure in lb. per square inch,  
d = depth of the girder at centre in inches,  
t = effective thickness of the girder at centre in 32nds of an inch,  
L = length, in inches, measured between the tube plate and back chamber plate inside, or between tube plates in chambers common to two opposite furnaces,  
P = pitch of stays supported by the girder in inches,  
D = distance apart of girders, centre to centre in inches,  
S = minimum tensile strength of the steel plates forming the girder, in tons per square inch. In the case of forged girders S is to be taken as 24 for iron and 28 for steel,

$$C = \begin{cases} \frac{n}{n + 1} \times 495 \text{ when } n \text{ is odd,} \\ \frac{n + \frac{1}{2}}{n + 2} \times 495 \text{ when } n \text{ is even,} \end{cases}$$

Where n = number of stays in a girder.

Girders attached to combustion chamber plates by welding may be accepted if of equivalent strength.

**239. Plain Smoke Tubes**

The following table may be used to obtain the working pressure allowed on plain iron or steel smoke tubes:

Outside Diameter in inches	Standard Thicknesses in S.W.G.				Working Pressures in lb. per square inch			
Inches	A	B	C	D	A	B	C	D
2	—	11	10	9	—	155	215	300
2½	11	10	9	8	140	190	260	330
2¾	11	10	9	8	125	175	230	300
2½	11	10	9	8	110	160	215	275
3	10	9	8	7	140	190	250	300
3½	10	9	8	7	130	180	230	280
3¾	10	9	8	7	120	165	215	260

**240. Doors**

Doors should be of steel. The doors to manholes, handholes and sight-holes should be built up or pressed to shape and annealed, or made from one thickness of plate with a machined recess for the jointing material. The spigot part or the recess should not have a greater clearance than 1/16 inch all round, i.e. the axes of the doors should not be less than those of the holes in which they are fitted by more than 1/4 inch.

The studs of all doors should be screwed through the plate, and should be fitted with nuts on the inside, or bolts may be used screwed through the plate with the heads inside.

**241. Hydraulic Tests**

For hydraulic tests on boilers see paragraph 247.

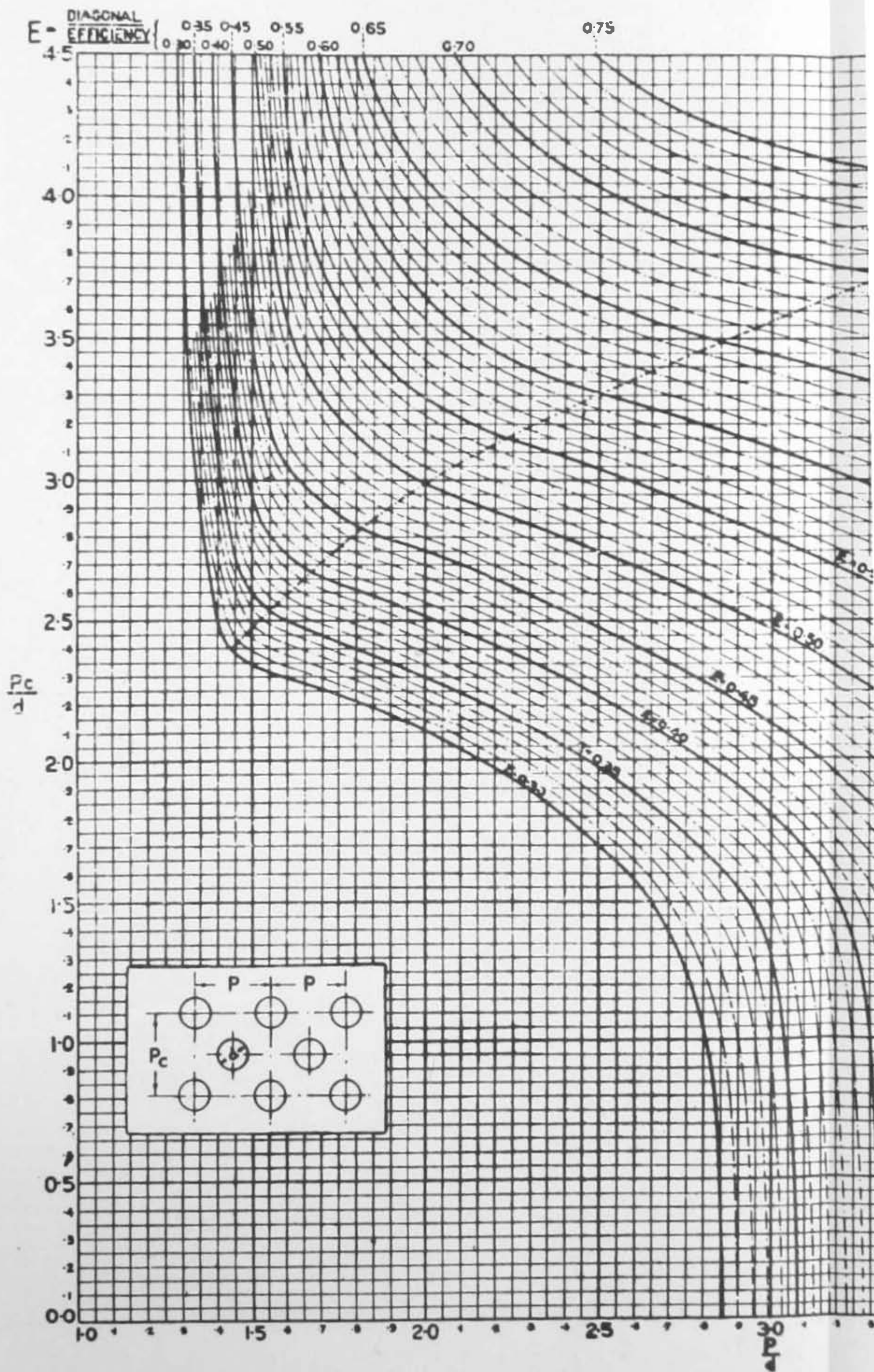
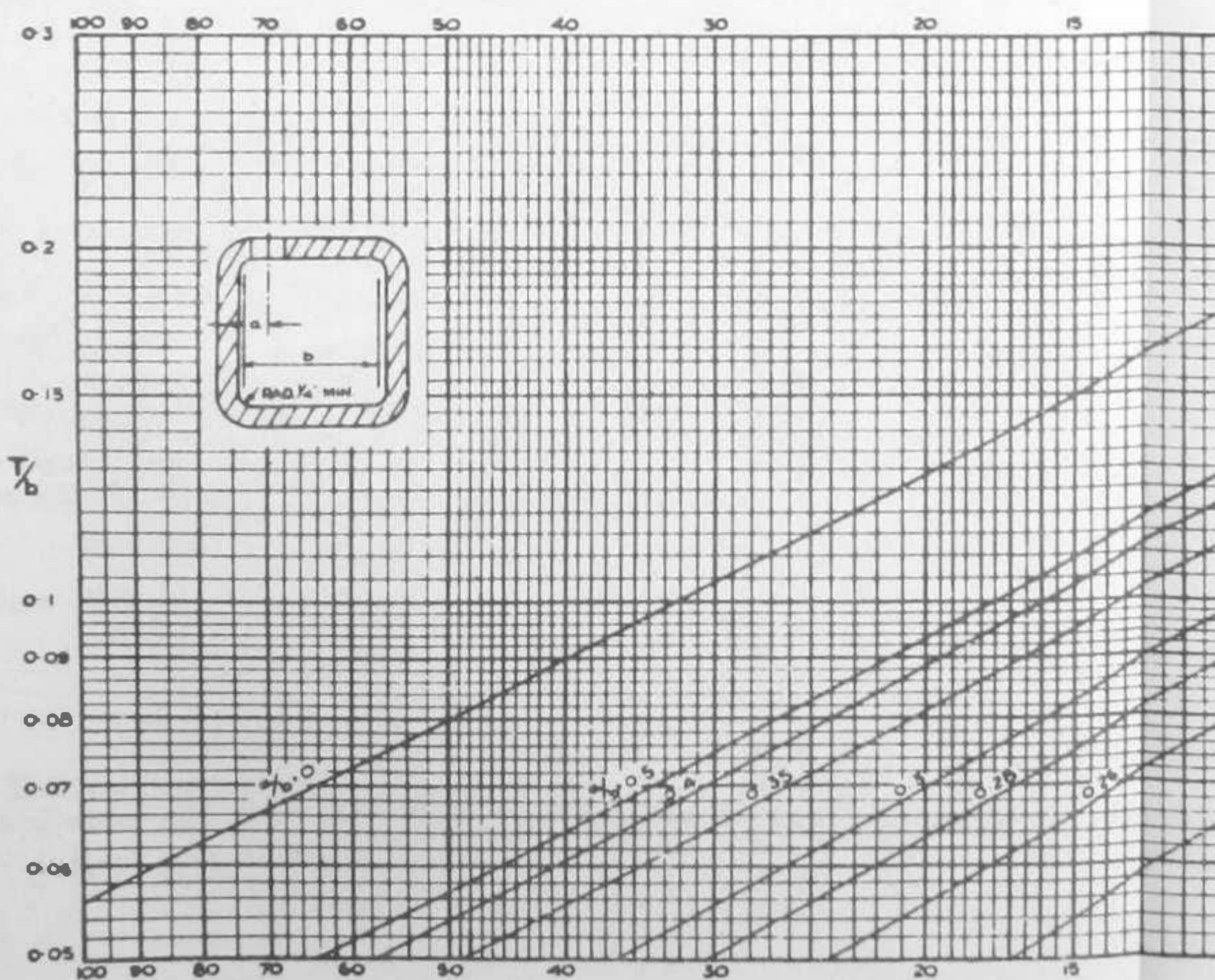
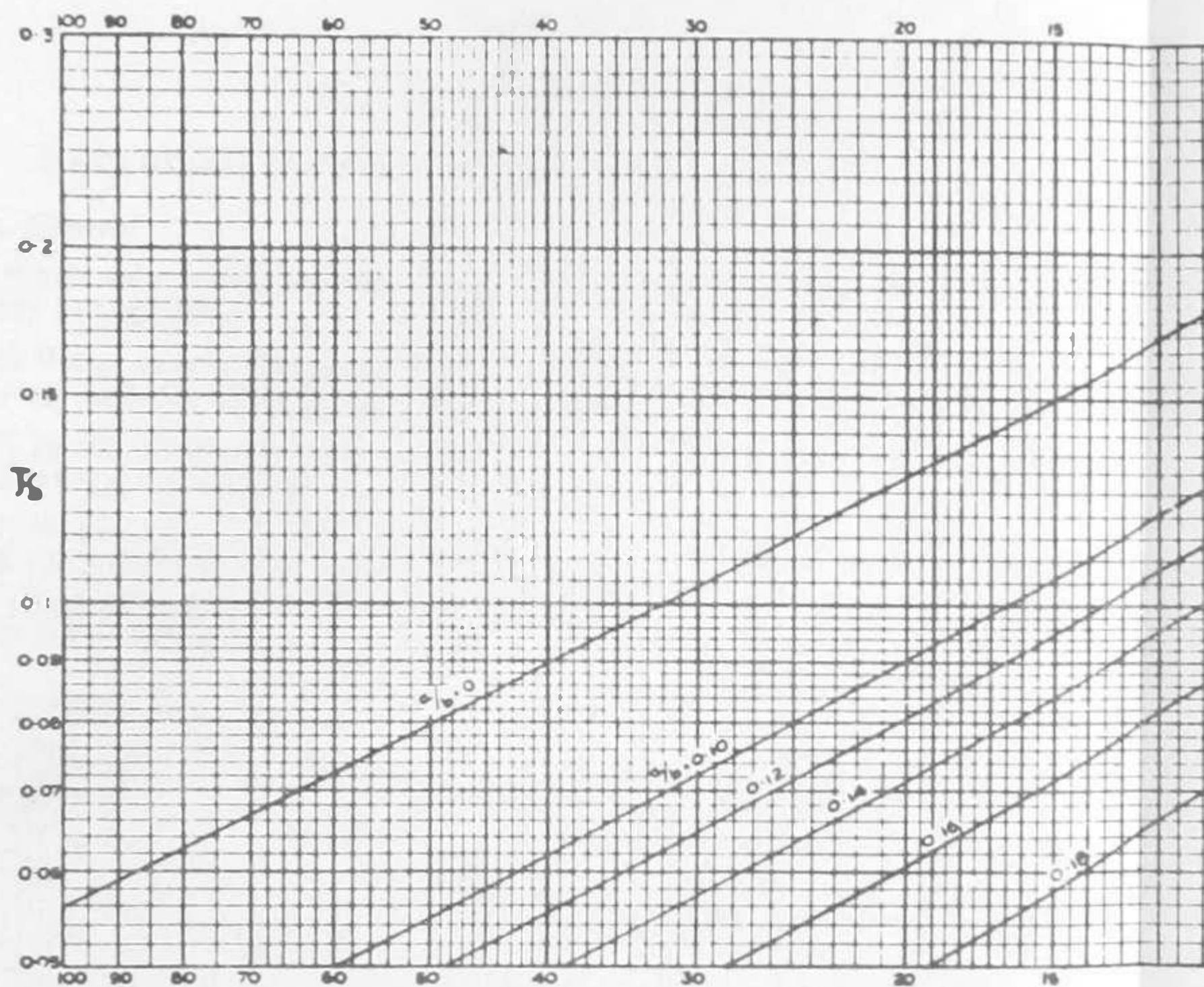


CHART FIG. N° 1











## Chapter 4

### WATER TUBE BOILERS

(INCLUDING INTEGRAL SUPERHEATERS AND ECONOMISERS)

#### 242. General

(a) Water tube boilers should comply with the requirements of paragraphs 214 to 241 as applicable.

(b) Water tube boilers should be so designed as to ensure efficient circulation over all surfaces exposed to the heat of combustion under service conditions.

(c) In all drums and headers access holes are to be provided for internal examination and cleaning.

(d) Water tube boilers the designs of which comply with British Standard 1113:1951, and which are constructed under the Ministry's survey are acceptable, but a hydraulic test as specified in paragraph 247 should be applied to all new water tube boilers.

#### 243. Cylindrical Drums

(a) The requirements of this paragraph apply to parts which are intended to be subjected to a working temperature not exceeding 650°F. Where the design steam temperature exceeds 650°F. special consideration will be given.

(b) Where the seams of boiler drums are welded, the design, construction and weld tests may be in accordance with the requirements of paragraphs 253 to 299 as applicable.

(c) Riveted longitudinal joints of cylindrical drums of water tube boilers, the internal diameters of which are less than 100 times the thickness of the plates at the joints, should not be of the lapped type, but should be butt jointed with double butt straps.

(d) Where the tube plate of a water tube boiler drum is thicker than the wrapper plate, the tube plate in way of the longitudinal joint or seam should be reduced in thickness to that of the wrapper plate. The reduction in thickness should be gradual and effected by machining; the plate thickness should be reduced by an equal amount on each side of the plate. The riveted joints or welded seams should be arranged clear of the tapered portions of the plate.

(e) Where cylindrical drums or headers of water tube boilers are of riveted construction, the working pressure on the unpierced shells or wrapper plates may be obtained from the formulae given in paragraph 222.

(f) The working pressure on the unpierced part of cylindrical seamless steel drums may be obtained from the following formula:

$$\text{W.P.} = \frac{(t - 2) \times S \times 35}{D}$$

Where W.P. = working pressure in lb. per square inch,

D = internal diameter of the drum in inches,

S = minimum tensile strength of the material in tons per square inch,

t = thickness of the shell in 32nds of an inch.

(g) The working pressure on the tube plates forming portions of cylindrical drums of water tube boilers may be obtained from the following formula:

$$\text{W.P.} = \frac{(t - 4) \times S \times J}{3 \times D}$$

Where W.P. = working pressure in lb. per square inch,  
 D = internal diameter of the drum in inches,  
 S = minimum tensile strength of the tube plate in tons per square inch,  
 t = thickness of the plate in 32nds of an inch,  
 J = minimum percentage strength of the plate through the tube holes, being the least value found from:

- (i) Longitudinally,  $\frac{(p - d)}{p} \times 100$
- (ii) Diagonally,  $E \times 100$ , where a drum is drilled for tube holes forming a staggered arrangement of holes, the diagonal efficiency E being obtained from the chart Fig. No. 1,

Where p = longitudinal pitch of the tubes in inches,  
 p<sub>c</sub> = circumferential pitch of the tubes in inches,  
 d = mean diameter of tube holes in inches.

In welded drums where tube holes pass through welded seams the efficiency of the welded seam should be allowed for and details should be submitted to the Engineer Surveyor-in-Chief for consideration.

(h) Where the bottom of the steam drum is exposed to radiation from the fire, or to the impingement of hot gases, and is not protected by tubes, a shield of refractory material should be provided or the tube plate should be suitably thinned at that part.

(j) The factor of safety must in no case be less than 4.

#### **244. Drum Ends**

The working pressure on drum ends dished from plate and having the pressure on the concave side may be obtained from the formulae in paragraph 223.

#### **245. Cylindrical and Rectangular Headers and Similar Fittings**

(a) When the working metal temperature does not exceed 900°F., headers and similar fittings may be of wrought or cast carbon steel. The material should comply generally, except as regards the lower tensile limit, with the requirements of paragraphs 194 to 197 for wrought steel and 202 to 205 for cast steel. Proposals for the use of other materials should be submitted to the Engineer Surveyor-in-Chief for consideration.

(b) The inspection or access doors must be substantial and capable of being removed and replaced from time to time without loss of efficiency. Where they are held in place by bolts the doors must be so designed that they will not blow out should the bolts fail.

(c) Each extended opening or cast nozzle on a header and each flange, forged or cast integral with the header, must have a fillet with a radius of not less than the thickness of the neck at that part.

(d) The thickness of seamless wrought steel cylindrical headers may be obtained from the appropriate formula given in paragraph 243, but where the working metal temperature (see 'f' in sub-paragraph (e) of this paragraph) exceeds 650°F., the value of S used in the formula should be reduced in the same ratio as the nominal stresses given in Table I for the appropriate ultimate tensile strength and working metal temperature.

(e) The thickness of flat surfaces of rectangular solid forged or cast headers (exclusive of staggered, sinuous or corrugated headers) should be not less than

$T + \frac{1}{16}$  inch, where the basic thickness  $T$  adjacent to the corners or at the ligaments between openings is derived from the Chart Fig. 2 which gives values of the ratio of  $T$  to 'b' for values of  $K$ ,

$$\text{Where } K = \frac{fE}{P}$$

Depending upon the proportions of the header, the thickness will be determined either by the stress at the corners or by the stress at the ligaments between tube holes and hand holes.

It is thus necessary to make two examinations:

- (i) At the corners clear of the tube holes where  $\frac{a}{b} = 0$  and  $E = 1.0$ .
- (ii) At the ligaments where  $\frac{a}{b}$  represents the position of the line of holes in the face of the header and  $E$  is calculated from the dimensions and pitch of openings.

Where  $T$  = basic thickness of header in inches,

$b$  = distance in inches between the sides supporting the surface under consideration less one corner radius 'r'. In no case, however, should 'b' be taken as less than 0.9 of the distance between the supporting sides,

$P$  = design pressure in lb. per square inch,

$E$  = efficiency of ligaments between tube holes or hand holes expressed as a fraction; due regard must be given to the diagonal ligament efficiency.

NOTE. Where a header is drilled with more than one row of holes the efficiency leading to the greatest thickness should be employed.

$a$  = distance between centre of opening and the limit of the effective breadth 'b' see Chart Fig. 2,

$f$  = nominal stress at working metal temperature (see Table I).

The working metal temperature should be taken as:

- (i) For saturated steam and water headers, the saturation temperature corresponding to the design pressure  $P$  plus 50°F.
- (ii) For superheater headers, the designed maximum steam temperature for that header plus 50°F.

NOTE. Where headers are adequately protected from the gases of combustion or are swept by such gases in the third or subsequent pass of a boiler, the working metal temperature should be taken as the saturation or designed maximum steam temperature whichever applies. A covering of refractory or insulating material which may be liable to become dislodged will not be considered adequate protection.

If the faces of the headers are machined locally at the hand holes the thickness of that part may be as much as  $\frac{5}{32}$  inch less than the thickness  $T$ , but irrespective of the thickness  $T$  obtained by the use of the above formula the thickness in inches of the headers at the tube holes should be not less than:

$$T_1 = 0.1\sqrt{D} + 0.25$$

Where  $T_1$  = thickness of header at the tube hole in inches,

$D$  = diameter of the tube hole in inches.

In no case should the thickness be less than  $\frac{1}{16}$  inch except that, in small patches not exceeding one-half a square inch in area, the thickness may be 50 per cent. of the thickness obtained from Chart Fig. 2.



TABLE 1. NOMINAL STRESSES AT WORKING METAL TEMPERATURES  
FOR RECTANGULAR SECTION HEADERS

Working metal temperature	Nominal Stress					Cast Steel to B.S. 592: 1950 Grade A
	Wrought Carbon Steel					
	Ultimate tensile strength 24-28 ton/sq. in.	Ultimate tensile strength 26-30 ton/sq. in.	Ultimate tensile strength 28-32 ton/sq. in.	Ultimate tensile strength 32-36 ton/sq. in.	Ultimate tensile strength 34-38 ton/sq. in.	Minimum Ultimate tensile strength 28 ton/sq. in.
Degrees F.	lb./sq. in.	lb./sq. in.	lb./sq. in.	lb./sq. in.	lb./sq. in.	lb./sq. in.
Up to 550	12,200	13,200	14,300	16,400	17,300	10,000
600	12,200	13,200	14,300	16,400	17,300	9,000
650	12,200	13,200	14,300	16,400	17,300	8,000
700	12,000	13,000	13,800	15,600	16,500	7,560
750	11,000	11,700	12,300	13,600	14,200	7,200
800	9,700	10,100	10,500	11,200	11,600	6,750
850	8,100	8,300	8,500	8,900	9,100	6,300
900	6,300	6,300	6,300	6,300	6,300	4,400

NOTE: Intermediate values may be interpolated.

246. Tubes of Water Tube Boilers and Connected Superheaters and Economisers

- (a) The tubes should comply with the requirements of paragraph 192.
- (b) Tubes may be expanded, expanded and welded, or strength welded into holes in the tube plates. Where a tube is expanded it should project through the neck or bearing part by at least a quarter of an inch and it should be secured from drawing out at each end. If this is done by bellmouthing, the bellmouthing should be  $\frac{1}{8}$  inch for each inch in external diameter plus  $\frac{1}{4}$  inch, i.e. the increase of diameter at the outer end of the bellmouth for a tube 2 inches in diameter will be  $\frac{1}{2}$  inch. Where tubes are secured by strength welding the weld should be effectively stress relieved.
- (c) Where the tubes are to be expanded, the tube holes in the tube plates of drums, pockets, or headers must be formed in such a way that the tubes can be effectively tightened in them. Where the tube ends are not normal to the tube plates, there should be a neck or belt of parallel seating of at least  $\frac{1}{8}$  inch in depth measured in a plane through the axis of the tube at each hole. Where the tubes are practically normal to the tube plate or header this parallel seating should not be less than  $\frac{1}{8}$  inch in depth.
- (d) The minimum thickness of tubes may be obtained from the following formula in conjunction with Tables 2, 3 and 4.

$$T = \frac{PD}{2f} + C$$

- Where T = minimum thickness of the tube in inches (minus tolerance to be added where necessary)
- P = design pressure in lb. per square inch,
- D = outside diameter of the tube in inches,
- f = nominal stress in lb. per square inch at working metal temperature (see Table No. 2)
- C = an additional thickness in inches (see Table No. 3).

The working metal temperature should be taken as:

- (i) For the boiler tubes, the saturation temperature corresponding to the pressure P, plus 25°F.
- (ii) For convection superheater tubes, the maximum steam temperature for which the part of the element is designed, plus 50°F.
- (iii) For radiant superheater tubes, the designed maximum temperature plus more than 50°F., the amount depending on the superheater design.

(e) Downcomer tubes and pipes not exposed to the heat of flue gases and forming an integral part of the boiler should be of seamless steel and should be generally in accordance with the requirements for steam pipes.

TABLE 2. NOMINAL STRESSES AT WORKING METAL TEMPERATURES FOR TUBES

Working Metal Temperature	Nominal Stress		
	Mild steel tubes	Half per cent. molybdenum steel tubes to BS1652 ultimate tensile strength 25-33 ton/sq. in.	Chromium molybdenum steel tubes to BS1653 tensile strength 25-33 ton/sq. in.
Degrees F.	lb./sq. in.	lb./sq. in.	lb./sq. in.
Up to 650	10,000	12,000	12,000
700	9,600	12,000	12,000
750	9,000	12,000	12,000
800	8,000	12,000	12,000
850	6,800	12,000	12,000
900	5,500	11,600	11,600

NOTE: Intermediate values may be interpolated.

TABLE 3. ADDITIONAL THICKNESS OF TUBES IN SPECIFIED POSITIONS

Position	Additional thickness C in inches
First two rows of generating tubes, and unprotected furnace wall tubes	0.08
Remainder of generating tubes, protected furnace wall tubes, plain economiser tubes and radiant superheated tubes	0.06
Tubes other than above and economiser tubes where fitted with cast iron gills	0.04

TABLE 4. MINIMUM NOMINAL THICKNESS OF TUBES

Outside diameter of tubes in inches	Nominal thickness	
	Cold drawn	Hot finished
	S.W.G.	S.W.G.
Up to and including 2	13	10
Over 2 up to and including 3	12	10
Over 3 up to and including 3½	10	10
Over 3½ up to and including 4½	9	9

## 247. Hydraulic Tests of Boilers and Superheaters

(a) Before witnessing hydraulic tests of boilers Surveyors must satisfy themselves that the boilers are suitable for the intended working pressure.

(b) New boilers including superheaters should be hydraulically tested to  $1\frac{1}{2}$  times the maximum working pressure plus 50 lb. per square inch when such working pressure is more than 100 lb. per square inch, and to twice the maximum working pressure when such working pressure is 100 lb. per square inch or less.

(c) Boilers which have been in service and which can be inspected internally should, when hydraulic testing is required, be tested to  $1\frac{1}{2}$  times the maximum working pressure, but the full hydraulic test as required for new boilers should, in general, be applied to the boilers of ships which have not previously held a passenger certificate, and also, at each annual survey, to boilers which are too small to permit of internal examination.

(d) The hydraulic test pressure should be maintained for a period of at least thirty minutes.


(e) Surveyors witnessing hydraulic tests should satisfy themselves that the tests are being properly carried out, and should inspect the boiler thoroughly while it is under test.

(f) If a test is unsatisfactory, the boiler should be retested after defects have been made good.

(g) When witnessing hydraulic tests, Surveyors should use the test pressure gauges supplied by the Ministry.

(h) Particulars of hydraulic tests, including the date, and stamping should be recorded in the office hydraulic test book.

(j) Stamping of Boilers. On completion of the survey of a new boiler it is to be stamped as follows:

M.  T.  
TESTED TO ..... LB.  
W.P. .... LB.  
DATE  
SURVEYOR'S INITIALS

In addition it is desirable that where applicable the pressure to which the superheater safety valves are set should be added below the W.P. thus:

Spt. S.V. .... lb.

Single-ended boilers should be stamped on the front end plate near the furnace door on the right hand side facing the boiler or on the adjacent part of the shell; double-ended boilers should be similarly marked at both ends. Vertical boilers should be stamped on the shell immediately over the fire-hole, and water-tube boilers on the steam drum over the manhole. Waste heat boilers which have no fire-hole should be stamped over the manhole. The stamping should be clear of the radius of the fire-hole or manhole.

For the definition of Working Pressure see paragraph 214(h)—Chapter 3.

## SUPERHEATERS

### 248. General

Superheaters are to be so designed as to ensure steam circulation over every part of the surfaces exposed to heat or flame under working conditions. Completed superheaters should be tested to the same hydraulic test pressure as the boilers of which they form part or to which they are connected.

Superheaters for water tube boilers the designs of which comply with British Standard 1113:1951 and which are constructed under the Ministry's survey are acceptable, but a hydraulic test as specified in paragraph 247 should be applied to all new superheaters.



#### **249. Tubular Superheaters Attached to Cylindrical Boilers**

- (a) The headers should be of steel and comply with paragraph 245.
- (b) The tubes should comply with the requirements of paragraph 192.
- (c) The minimum thickness of the tubes should be determined by the following formula:

$$t = \frac{(WP \times d)}{75} + 5$$

Where WP = working pressure in lb. per square inch,  
t = thickness of the tubes in 100ths of an inch,  
d = external diameter of the tubes in inches.

- (d) Where necessary the tubes should be suitably bellmouthed in the headers to the extent required for the tubes of water tube boilers.

#### **250. Superheaters of Water Tube Boilers**

- (a) Superheaters connected to water tube boilers should comply with the requirements for boilers of that type as regards drums, headers, materials and construction.
- (b) The tubes should be of steel and comply with the requirements of paragraph 246.
- (c) Tubes which contain steam only should in general be situated in positions shielded from direct radiant heat.

#### **251. Safety Valves and Drains for Superheaters**

Superheaters that can be shut off from the main boilers should be fitted with safety valves in accordance with paragraphs 301 to 305.

Drains should in all cases be fitted to superheaters in which a collection of water in the bottom is possible, and suitable provision should be made to avoid overheating of the tubes when raising steam.

### **ECONOMISERS**

#### **252. Economisers Integral with or connected to Water Tube Boilers**

- (a) Economisers should, as regards their design, construction and the quality and tests of the materials used in their construction, comply with paragraphs 242 to 246 relating to water tube boilers where applicable
- (b) Where the economiser cannot be shut off from the boiler the design pressure should be that of the boiler.
- (c) Where the economiser can be isolated it should be fitted with an efficient type of safety valve which should prevent an increase in pressure beyond the design pressure of the economiser under any conditions.
- (d) Where the boiler feed arrangements can allow the economiser to be by-passed, the damper arrangements should be such that the products of combustion can also by-pass the economiser.
- (e) Where bolted joints are used to connect the pressure parts, the nuts should not be exposed to the products of combustion.
- (f) Economisers which cannot be shut off from the boiler should, on completion, be tested by hydraulic pressure to the same test pressure to which the boiler is subjected.

Economisers which can be shut off from the boiler should, on completion, be tested by hydraulic pressure to  $1\frac{1}{2}$  times the economiser safety valve pressure + 50 lb. per square inch.

## Chapter 5

### FUSION WELDED PRESSURE VESSELS

#### 253. *General*

(a) These instructions apply to fusion welded mild steel pressure vessels not less than  $\frac{3}{16}$  inch thick, and of normal design, where the operating temperature does not exceed 650°F.

Pressure vessels of abnormal design or designed to operate at temperatures exceeding 650°F. will be specially considered.

(b) Steel used in the construction of welded pressure vessels should be tested and should conform with the requirements of paragraphs 172 to 186.

(c) Drawings showing full constructional details of all welded pressure vessels should be submitted to the Engineer Surveyor-in-Chief for consideration before the work is put in hand. Details of the proposed preparation for welding, method of welding, tensile strength of the materials, heat treatment and weld tests should be shown.

(d) All pressure vessels should have means of access for the examination and cleaning of the inner surfaces. If entry is impracticable suitable hand holes or inspection holes are to be provided.

(e) After plates have been dished, flanged or locally heated they are to be efficiently heat treated unless during the last stage of manufacture they have been uniformly heated throughout.

#### 254. *Fusion Welding*

Fusion welding may be done by hand or by machine. The metal arc process using suitably covered electrodes or other electric arc process in which the arc stream and the deposited weld metal are shielded from atmospheric contamination, may be used.

Surveyors should satisfy themselves that the electrodes used and the process employed for metal arc welding comply with the above requirements.

Particulars of any other proposed welding process should be submitted for consideration.

#### 255. *Preparation of Plates for Welding*

The edges of plates which are to be welded should be machined or flame cut by machine.

Where the carbon content of plates which are to be flame-cut exceeds 0.26 per cent. the edges to be welded should be ground or machined.

Before welding begins the welding edges of all plates should be cleaned to a smooth metallic surface, free from rust, oil, or other foreign matter.

#### 256. *Method of Making Welded Seams*

Longitudinal and circumferential seams should be welded from both sides of the plate. Where however it is impracticable, because of the small size of the pressure vessel, to weld a seam efficiently from both sides of the plate, the seam may be welded from one side only but, ordinarily this method should not be allowed on Class I pressure vessels (see paragraph 259). The Surveyor should satisfy himself, however, that the technique used is such as to ensure full penetration and the use of backing strips is recommended.

For pressure vessels of Class I, the surfaces of the welds should be machined or ground so as to provide a smooth contour, and be flush with the respective surfaces of the plate. The position of all welds should be permanently marked to make them easy to find.

For pressure vessels of Class II and Class III (see paragraph 259) additional runs of weld metal may be deposited to reinforce longitudinal and circumferential seams. The change in contour should be gradual.

Each run of weld metal should be thoroughly cleaned and freed from slag before the next run is deposited.

There should be no undercutting at the side of the welds.

All welding should in general be done in the downhand position.

### **257. Cylindrical Shells**

Each shell plate should be of cylindrical form to the edge of the plate without "flats" at the welded seams, and any local departure from circularity should be gradual.

After the final heat treatment (where applicable), the difference between the maximum and minimum internal diameters of the shell, measured at any one cross section should not exceed one per cent. of the specified diameter.

Before welding is begun the surfaces of the plates at the longitudinal and/or circumferential seams should at no part be out of alignment with each other by more than 6 per cent. of the plate thickness, but in no case should the misalignment exceed  $\frac{1}{8}$  inch for the longitudinal seams or  $\frac{1}{4}$  inch for the circumferential seams.

### **258. Dished End Plates**

Dished end plates should in general be in one piece made from rolled plate. The dishing and peripheral flanging should be done by machine.

### **259. Classification of Fusion Welded Pressure Vessels (see also table 6)**

#### ***Class I***

Fired and unfired pressure vessels which exceed the limits of Classes II and III.

#### ***Class II***

Fired and unfired pressure vessels which do not exceed any of the following limits:

- (a) Fired pressure vessels: a maximum working pressure of 50 lb. per square inch.
- (b) Unfired pressure vessels: a maximum working pressure of 500 lb. per square inch.
- (c) Unfired pressure vessels: shell thickness  $1\frac{1}{2}$  inches.

#### ***Class III***

This class includes unfired pressure vessels which do not exceed any of the following limits:

- (a) Maximum working pressure 250 lb. per square inch.
- (b) Maximum working temperature 300°F.
- (c) Shell thickness  $\frac{3}{4}$  inch.

## **CLASS I FUSION WELDING**

### **260. Makers' Facilities and Methods**

Pressure vessels intended for acceptance as Class I should be manufactured by firms providing the following facilities and complying with the following requirements.

The works must be equipped with efficient welding plant and have suitable laboratory equipment available for making the required tests, for preparing and examining macro and micro specimens and for the radiographic examination of welded seams. There should be a satisfactory systematic procedure for the supervision of the welding operators, who should be subjected to periodic tests for quality of workmanship.



The Surveyor should satisfy himself by means of tensile, bend and impact tests, and micro, macro and radiographic examinations that the welding plant and equipment are efficient and the welding technique adopted is satisfactory. A pressure vessel typical of the firm's production should be inspected by the Surveyor during manufacture and a full report should be submitted to the Engineer Surveyor-in-Chief.

## 261. Tests on Welded Seams

Test plates representing all the welded seams should be prepared for each pressure vessel. Where there is only one longitudinal seam one set of tests is required but where there are two or more longitudinal seams two sets of tests representing different seams should be prepared.

Provision should be made for any necessary re-tests and the plate provided for this purpose may be an extension of the test plate as in Fig. 1 or may be at the opposite end of the same seam to which the test plate is attached.

If the cylindrical shell is formed in two or more rings the staggered longitudinal seam may be regarded as one seam for testing purposes, provided that the method of welding each longitudinal seam is the same and the welding is effected in one reasonably continuous operation by the same operator or operators or with the same setting if automatic machine welding is employed.

Where there are circumferential seams only, or where the method of welding the circumferential seams differs appreciably from that employed for the longitudinal seam, test plates representing the circumferential seams should be prepared.

Test plates representing the longitudinal seams should be securely attached to the shell and supported to prevent excessive distortion or warping. The weld groove formed by the test plates should be similar to that for the longitudinal seam. The seam in the test plates should be a continuation of the longitudinal seam and the weld metal in the longitudinal seam and the test plates should be deposited continuously at the one operation.

Test plates which have warped during welding should be straightened before being given the same heat treatment as that given to the pressure vessel.

The test plates should be cut from the parent plate or plates forming the appropriate seam, or alternatively the test plates may be cut from material having similar chemical and physical properties, the thickness being the same as that of the plate or plates forming the appropriate seam.

Where one test plate only is provided this portion is to be retained for possible retests.

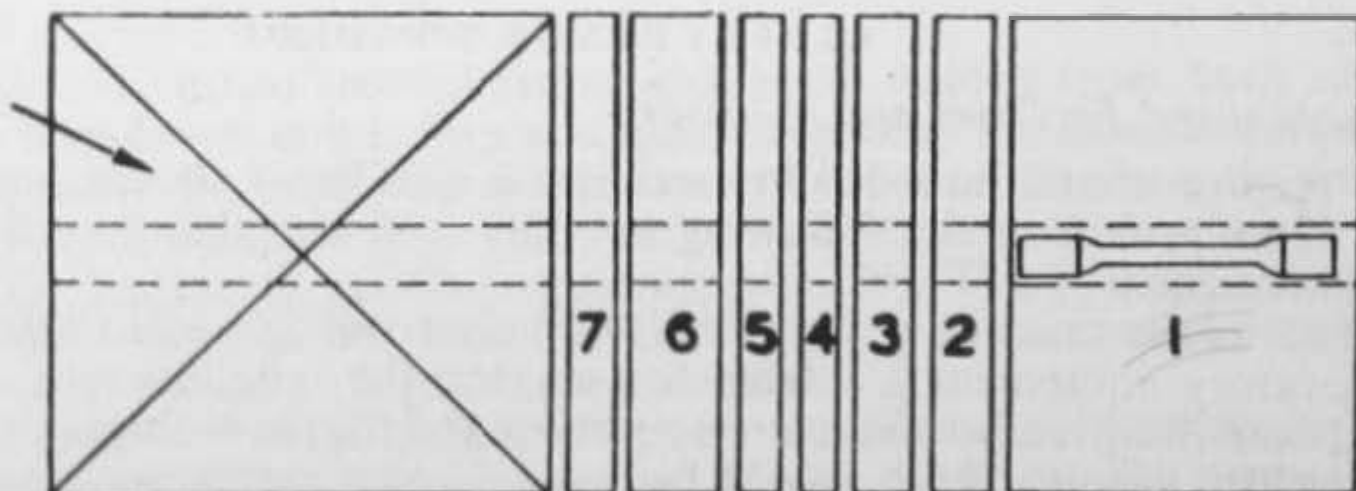


FIG. 1

A test plate should be cut up into specimens as shown in the Fig. 1 for the following tests:

- Specimen No. 1—Tensile (all weld metal)
- „ „ 2—Bend (inner surface)
- „ „ 3—Bend (outer surface)
- „ „ 4—Impact (inner surface)
- „ „ 5—Impact (outer surface)
- „ „ 6—Tensile (welded seam)
- „ „ 7—Macro and, if in any particular case it is desirable, also micro.

262. Tensile Test for Weld Metal Specimen No. 1

TABLE 5. DIMENSIONS OF ALL-WELD-METAL TEST PIECES

Diameter	Cross-Section area	Gauge Length	Parallel Length (minimum)
in.	sq. in.	in.	in.
0.798	0.50	2.82	3.18
0.564	0.25	2.00	2.25
0.505	0.20	1.79	2.01
0.479	0.18	1.70	1.91
0.452	0.16	1.60	1.80
0.437	0.15	1.55	1.74
0.424	0.141	1.50	1.69
0.399	0.125	1.41	1.58
0.357	0.100	1.26	1.42

The ultimate tensile strength of the weld metal should not be less than the lower limit specified for the plate. The elongation should not be less than 20 per cent. on the gauge length, and the reduction in area not less than 35 per cent. The physical properties of the weld metal should be similar to those of the plate.

263. Bend Test Specimens Nos. 2 and 3

The specimens should be rectangular in section and cut transversely to the weld and have a width equal to one and one-half times the thickness of the specimen. The corners may be rounded to a radius not exceeding 10 per cent. of the thickness of the specimen.

One specimen should be bent with the outer surface of the weld in tension, the other with the inner surface in tension.

Where the plate thickness does not exceed 1½ inches the thickness of the specimens should be equal to the full thickness of the test plate. Where the plate thickness exceeds 1½ inches the specimens should have a thickness of 1½ inches and should be prepared by discarding metal from the surfaces which will be in compression when the test is applied, see Figs. 2 and 3. Where the thickness of the plate permits, both specimens may be cut from the same piece of plate, see Fig. 4.

Any reinforcement of the weld should be machined or ground flush with the surface of the plates.

Each specimen is to be bent cold without fracture through an angle of 180° over a former having a diameter equal to three times the thickness of the specimen. The distance between the supports should be not more than 5.2 times the thickness of the specimen.

Outer surface

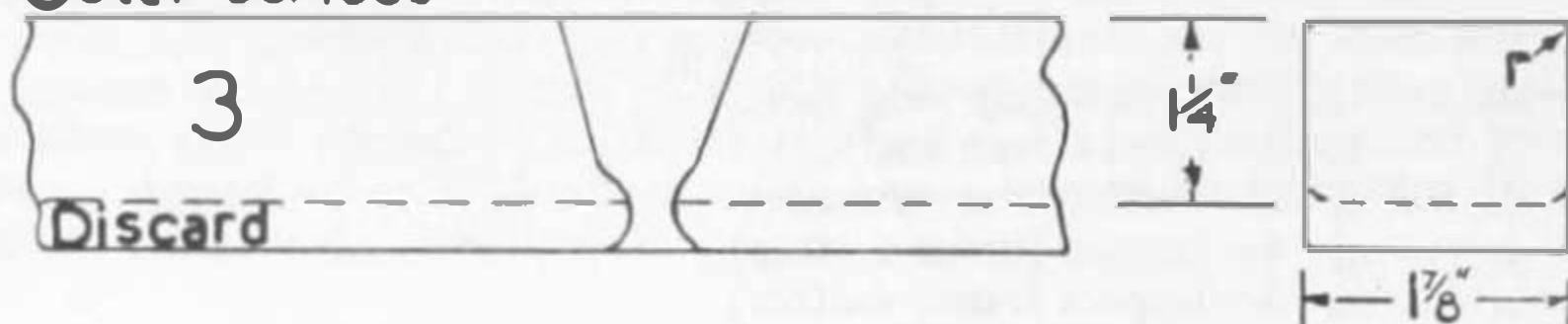
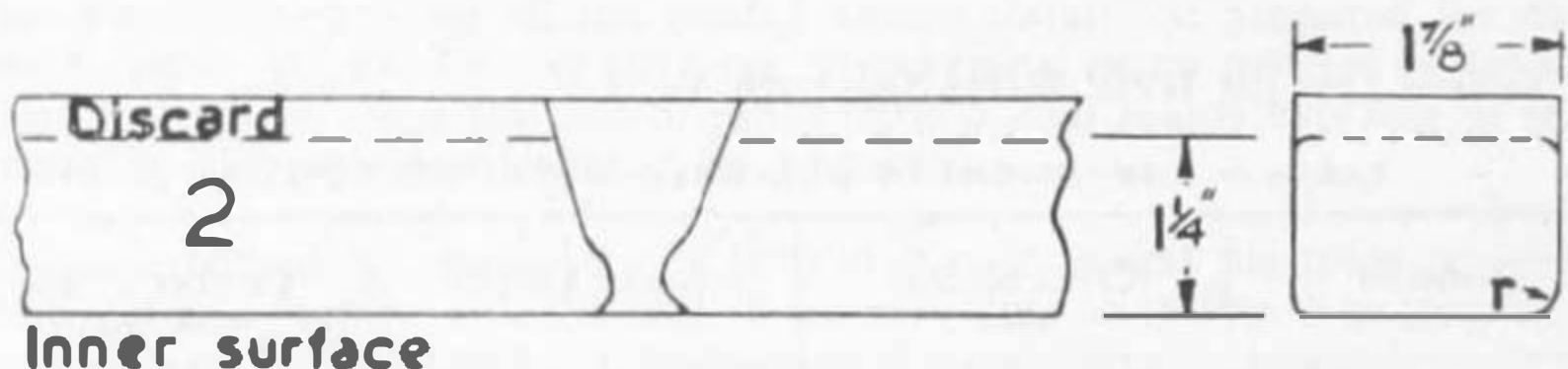
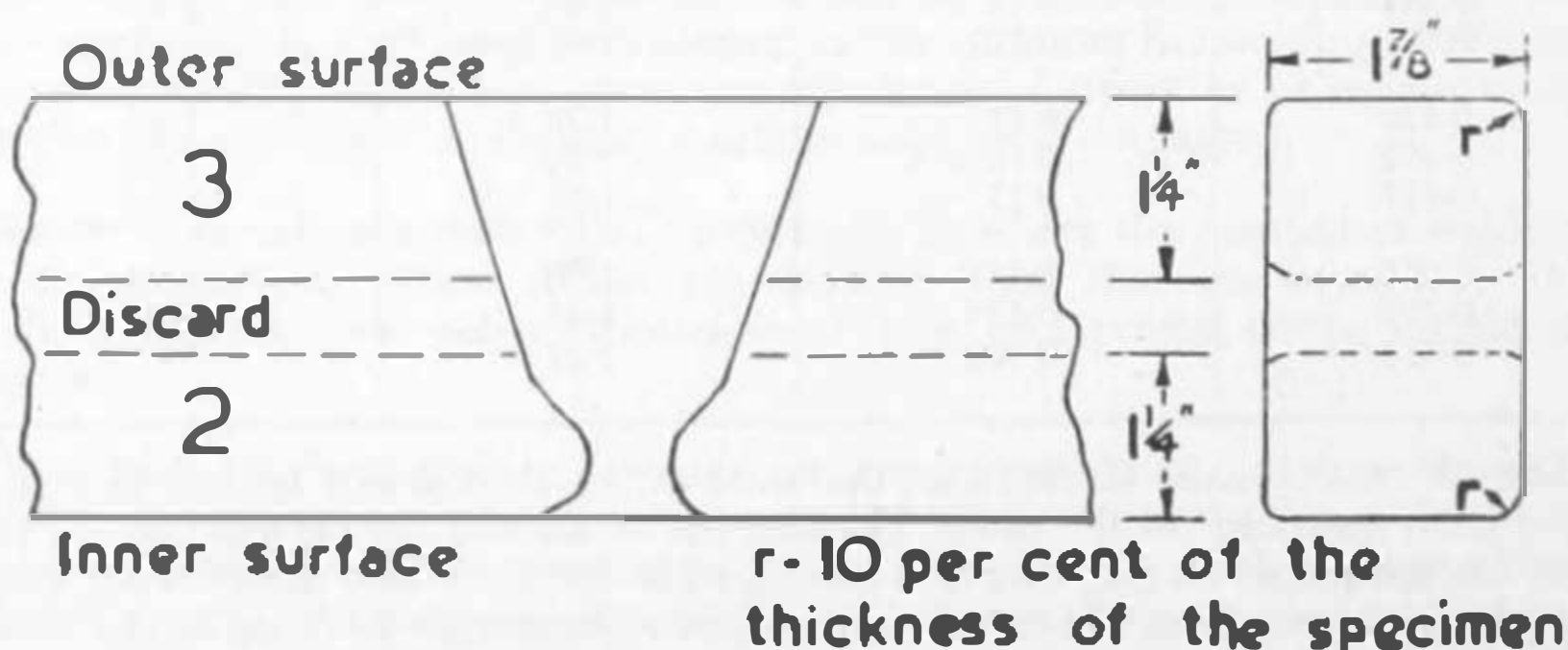


FIG. 2



Inner surface

FIG. 3



Inner surface

r - 10 per cent of the  
thickness of the specimen

FIG. 4

#### 264. Impact Test Specimens Nos. 4 and 5

The dimensions of the two specimens should be as shown in Fig. 5.

One specimen should have the notch cut at the middle of the outer surface of the weld and the other at the middle of the inner surface of the weld.

The test should show a minimum Izod impact value of 20 ft./lb., the test being carried out between 50°C. (122°F.) and 100°C. (212°F.).

#### 265. Joint Tensile Test Specimen No. 6

An equivalent form of test piece to that shown in Fig. 6 may be accepted.

Any reinforcement of the weld should be machined or ground flush with the surface of the plates. When the capacity of the testing machine does not allow the full thickness of a single specimen to be tested, two narrower tensile specimens may be substituted. These specimens should be the full thickness of the plate at the welded seam and their breadth should be as great as the testing machine will reasonably allow, provided the effective cross sectional area of the test piece is not less than 1 1/2 square inches.

The ultimate tensile strength should be not less than the lower limit specified for the plate.



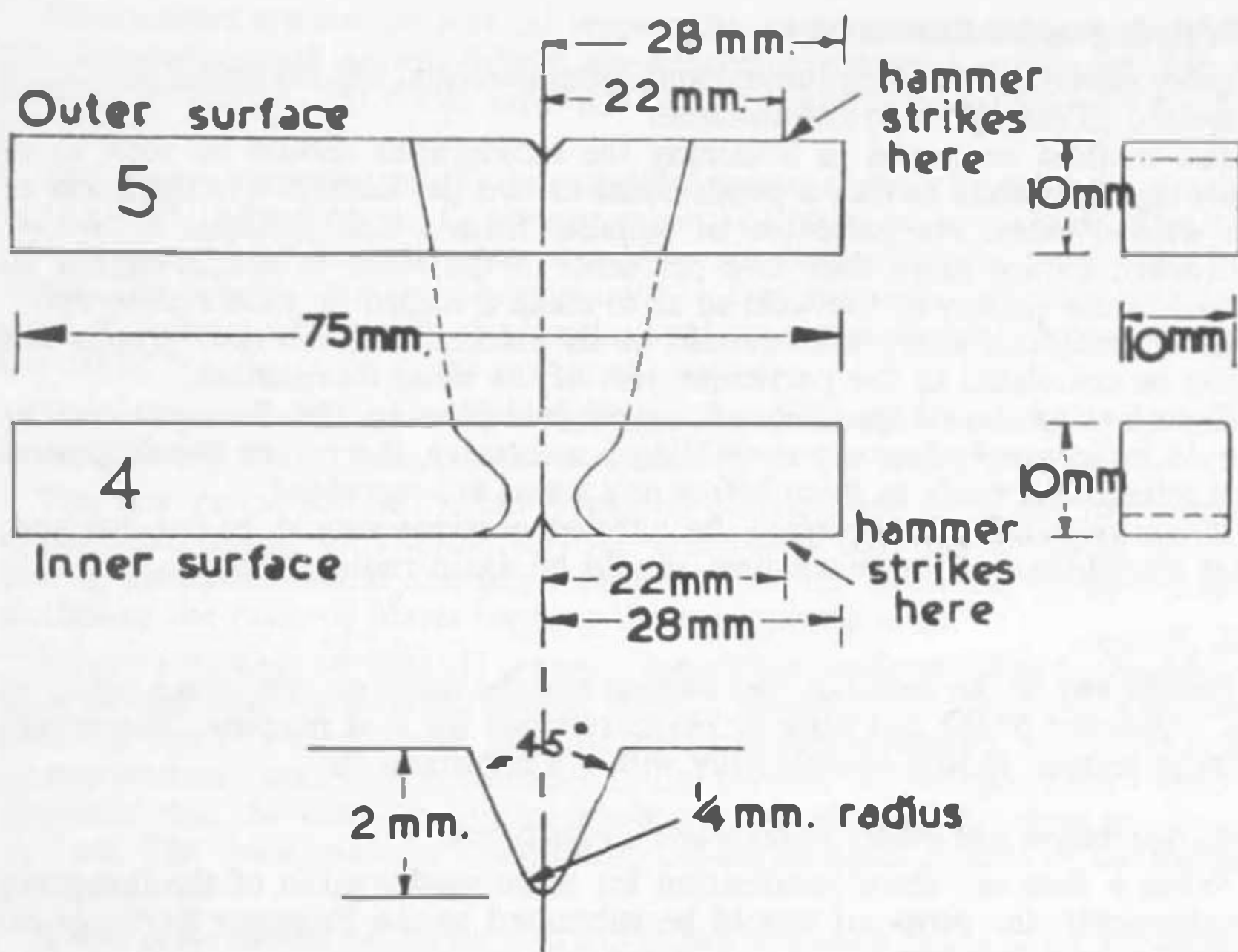
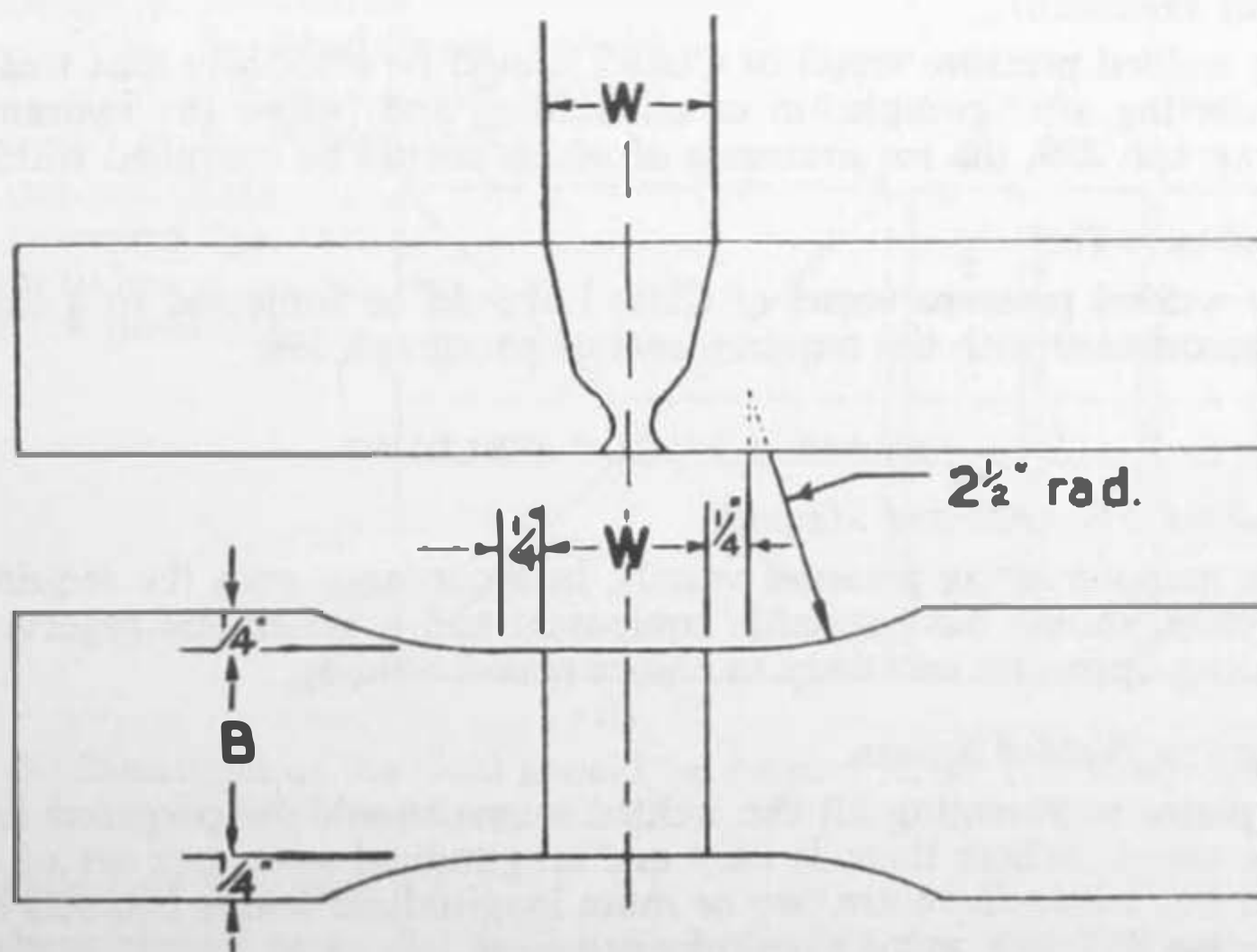


FIG. 5



B = not less than full plate thickness with a minimum width of 1 1/4 inches

FIG. 6

#### 266. Macro and Micro Specimen No. 7

A specimen taken in way of the weld and the full thickness of the plate should be prepared for the purposes of macro examination and, when required, micro examination.

### **267. Radiographic Examination**

Every portion of the longitudinal and circumferential welded seams should be subjected to radiographic examination.

The method employed in obtaining the radiographs should be such as to show clearly defects having a depth equal to two per cent. of the thickness of the welded seam. An indicator of suitable form which includes a portion equivalent to not more than two per cent. of the seam thickness should be placed in the vicinity of the weld so as to make a record on each radiograph.

Each section of every weld should be so marked that the radiographs can easily be correlated to the particular part of the seam represented.

Examination should be made of the original films by the Surveyor and he should indicate whether any re-welding is necessary. Surveyors should ensure that reference is made to them before any seams are re-welded.

If any re-welding is necessary the affected portions should be cut out and, after completion of the re-welding, should be again radiographed.

### **268. Re-tests**

Should any of the tests fail, two re-tests may be made on specimens cut from the remainder of the test plate or plates retained for that purpose. The results of both re-tests should comply fully with the requirements.

### **269. Alternative and modified Tests and Requirements**

When a firm can show justification for some modification of the foregoing requirements, the proposal should be submitted to the Engineer Surveyor-in-Chief for consideration.

### **270. Heat Treatment**

Every welded pressure vessel of Class I should be efficiently heat treated for stress relieving after completion of all welding and before the hydraulic test (see paragraph 289, the requirements of which should be complied with).

### **271. Hydraulic Test**

Every welded pressure vessel of Class I should be subjected to a hydraulic test in accordance with the requirements of paragraph 290.

## **CLASS II FUSION WELDING**

### **272. Makers' Facilities and Methods**

Firms manufacturing pressure vessels, in accordance with the requirements of this class, should have suitable equipment and a systematic supervision of the welding operators necessary to ensure sound welding.

### **273. Tests on Welded Seams**

Test plates representing all the welded seams should be prepared for each pressure vessel. Where there is only one longitudinal seam one set of tests is required but where there are two or more longitudinal seams two sets of tests representing different seams should be prepared.

Provision should be made for any necessary re-tests and the plate provided for this purpose may be an extension of the test plate as in Fig. 7 or may be at the opposite end of the same seam to which the test plate is attached.

If the cylindrical shell is formed in two or more rings the staggered longitudinal seam may be regarded as one seam for testing purposes provided the method of welding of each longitudinal seam does not differ and the welding is effected in one reasonably continuous operation by the same operator or operators or with the same setting if automatic machine welding is employed.

Where there are circumferential seams only, or where the method of welding the circumferential seams differs appreciably from that employed for the longitudinal seam, test plates representing the circumferential seams should be prepared.

Test plates representing the longitudinal seams should be securely attached to the shell and supported to prevent excessive distortion or warping. The weld groove formed by the test plates should be similar to that for the longitudinal seam. The seam in the test plates should be a continuation of the longitudinal seam and the weld metal in the longitudinal seam and the test plates should be deposited continuously at the one operation.

Test plates which have warped during welding should be straightened before being given the same heat treatment as that given to the pressure vessel.

The test plates should be cut from the parent plate or plates forming the appropriate seam, or alternatively the test plates may be cut from material having similar chemical and physical properties, the thickness being the same as that of the plate or plates forming the appropriate seam.

Where a number of Class II pressure vessels are made at the same works and at about the same time, and a similar welding technique is adopted in each case, each 120 feet of welded seam, longitudinal plus circumferential, may be regarded as one pressure vessel when considering the number of test specimens required, provided that the difference in thickness of the welded plates does not exceed  $\frac{3}{16}$  inch. The thickness of the test plates should be equal to that of the thickest welded plate.

A test plate should be cut up into specimens as shown in Fig. 7 for the following tests:

- Specimen No. 1—Tensile  
 „ „ 2—Bend (inner surface)  
 „ „ 3—Bend (outer surface)  
 „ „ 4—Nicked bend

Where one test plate only is provided this portion is to be retained for possible retests.

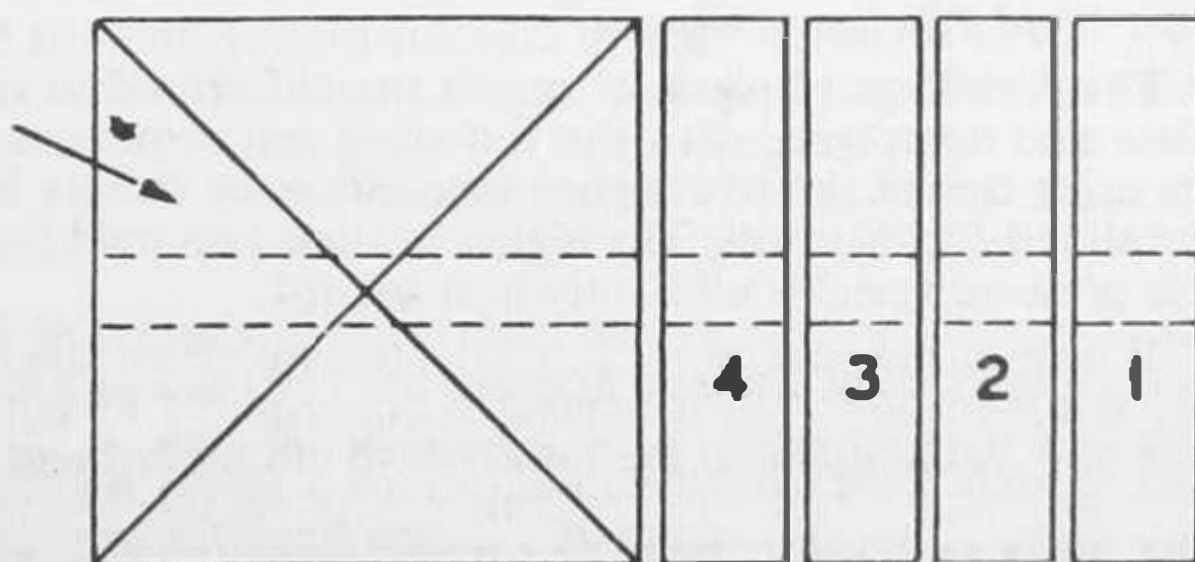


FIG. 7

Any reinforcement of the weld should be dressed flush. The sharp corners of the bend test specimens may be removed.

#### 274. Tensile Test Specimen No. 1

The shape should be similar to that shown in Fig. 6 and the ultimate tensile strength should be not less than the lower limit specified for the plate.

#### 275. Bend Test Specimens Nos. 2 and 3

The specimens should be rectangular in section and be cut transversely to the weld and have a width of not less than one and one-half times the thickness of the specimen. Each specimen is to be bent cold without fracture through an angle of 180° over a former having a diameter not greater than three times the thickness of the specimen.



One specimen should be bent with the outer surface of the weld in tension, the other with the inner surface in tension

#### **276. *Nicked Bend Test Specimen No. 4***

The specimen should be rectangular in section and be cut transversely to the weld so as to have a width of not less than one and one-half times its thickness. A slot or saw cut should be made in each side of the weld and the specimen broken. The fracture should reveal a sound homogeneous weld, substantially free from slag inclusion, porosity and coarse structure.

#### **277. *Retests***

Should any of the tests fail, two retests may be made on specimens cut from the remainder of the test plate or plates retained for that purpose. The results of both retests should comply fully with the requirements.

#### **278. *Heat Treatment***

Where heat treatment for stress relieving is required to be carried out, the requirements of paragraph 289 will apply.

#### **279. *Hydraulic Test***

Every welded pressure vessel of Class II should be subjected to a hydraulic test in accordance with the requirements of paragraph 290.

### **CLASS III FUSION WELDING**

#### **280. *Makers' Facilities and Methods***

Firms manufacturing pressure vessels, in accordance with the requirements of this class, should have suitable equipment and a systematic supervision of the welding operators necessary to ensure sound welding.

#### **281. *Weld Efficiency Factor***

The scantlings of pressure vessels, manufactured to the requirements of this class and complying with the following test requirements, may be calculated by using one of the two higher weld efficiency factors  $E$  given in table 6 paragraph 291 for this class. The higher of these two weld factors may be used when the pressure vessel is efficiently heat treated

Where in the case of a Class III pressure vessel the following material tests are not made and heat treatment is not required by paragraph 289 a hydraulic test only being applied, the lowest weld efficiency factor  $E$  should be used.

#### **282. *Tests on Welded Seams***

One test plate representing the longitudinal seams should be attached to the shell. The test plate should be of a size sufficient for the preparation of the test specimens and for any retest specimens that may be required. The test plate should be securely attached to the shell and supported to prevent excessive distortion or warping.

The weld groove formed by the test plates should be similar to that for the longitudinal seam. The seam in the test plate should be a continuation of the longitudinal seam and the weld metal in the longitudinal seam and the test plate should be deposited continuously in the one operation.

Test plates which have warped during welding should be straightened before being given the same heat treatment, if any, as that given to the pressure vessel.

Where pressure vessels of Class III have circumferential seams only, test plates are not required.

The test plates should be cut from the parent plate or plates, or alternatively the test plates may be cut from material having similar chemical and physical properties, the thickness being the same as that of the plate or plates forming the appropriate seam.

Where a number of Class III pressure vessels are made at the same works and at about the same time, and a similar welding technique is adopted in each case, each 120 feet of welded seam, longitudinal plus circumferential, may be regarded as one pressure vessel when considering the number of test specimens required, provided that the difference in thickness of the welded plates does not exceed  $\frac{3}{16}$  inch. The thickness of the test plates should be equal to that of the thickest welded plate.

The test plate should be cut up to provide specimens for the following tests:  
Specimen No. 1—Tensile

„ „ 2—Bend

„ „ 3—Nicked Bend

Any reinforcement of the weld may be dressed flush. The sharp corners of the bend test specimens may be removed.

### **283. Tensile Test Specimen**

The shape should be similar to that shown in Fig. 6 in paragraph 265 and the ultimate tensile strength should not be less than 95 per cent. of the lower limit specified for the plate.

### **284. Bend Test Specimen**

The specimen should be rectangular in section and be cut transversely to the weld and have a width of not less than one and one-half times the thickness of the specimen.

The specimen should be bent without fracture through an angle of 160° over a former the diameter of which should not be greater than three times the thickness of the specimen.

### **285. Nicked Bend Specimen**

The specimen should be rectangular in section and be cut transversely to the weld so as to have a width of not less than one and one-half times its thickness. A slot or saw cut should be made in each side of the weld and the specimen broken. The fracture should reveal a sound homogeneous weld, substantially free from slag inclusions, porosity and coarse structure.

### **286. Retests**

Should any of the tests fail, two retests may be made on specimens cut from the remainder of the test plate retained for that purpose. The results of both retests should comply fully with the requirements.

### **287. Heat Treatment**

Where heat treatment for stress relieving is required to be carried out, the requirements of paragraph 289 will apply.

### **288. Hydraulic Test**

Every welded pressure vessel of Class III should be subjected to a hydraulic test in accordance with the requirements of paragraph 290.

## HEAT TREATMENT

**289.** It is recommended that all welded pressure vessels should be stress relieved by heat treatment.

Heat treatment for stress relieving must, in any case, be given to the following:

- (a) All pressure vessels of Class I.
- (b) All fired pressure vessels of Class II.
- (c) All pressure vessels of Classes II or III where heat treatment is required in order to use the highest efficiency factor E, see table 6.
- (d) All pressure vessels of Classes II or III where the shell thickness at the welded longitudinal or circumferential seams in 32nds of an inch exceeds  $\frac{d}{3.5} + 7$  (where d is the internal diameter in inches).
- (e) Vessels of Classes II or III where, because of complex design or unusual conditions of service, heat treatment is considered necessary.

Where pressure vessels require to be stress relieved by heat treatment, this should be done after completion of all welding and before the hydraulic test.

Heat treatment should be carried out in a properly constructed and suitably equipped furnace sufficiently large to accommodate the whole vessel. The furnace temperature should be slowly raised to between 600°C. and 650°C. and maintained at that temperature until the vessel has uniformly heated through. The vessel may be allowed to cool in the furnace, but if withdrawn it should be screened from draughts while cooling.

The weld test plates should be inside the vessel when it is being heat treated

In special cases, however, it may be permissible to heat treat the weld test plates separately from the vessel, provided the Surveyor is satisfied with the means adopted to ensure that the following factors will be the same for the vessel and for the test plates:

- Rate of heating
- Maximum temperature
- Time held at maximum temperature
- Conditions of cooling

Alternative methods of heat treatment should be submitted to the Engineer Surveyor-in-Chief for consideration.

## HYDRAULIC TEST

**290.** On completion all welded pressure vessels should be tested by hydraulic pressure to one and one-half-times the maximum working pressure plus 50 lb. per square inch when such working pressure is more than 100 lb. per square inch, or to twice the maximum working pressure when such pressure is 100 lb. per square inch or less.

While under test, the vessels are to be well hammered on both sides of, and close to, the welded seams.

Welded pressure vessels through which the feed water passes from the feed pumps to the boilers should be tested by hydraulic pressure to two and one-half times the maximum boiler pressure or to twice the maximum working pressure in the feed line, whichever is the greater.

For welded pressure vessels subject to oil fuel pressure (see paragraphs 365(c) and 366).



## DETERMINATION OF WORKING PRESSURE

### 291. Cylindrical Shells

For the unpierced cylindrical portions of shells the working pressure to be allowed should be calculated from the following formula:

$$\text{W.P.} = \frac{(t - 2) \times S \times E \times 35}{D}$$

Where W.P. = working pressure in lb. per square inch,

$t$  = minimum thickness of the cylindrical portion of the shell in 32nds of an inch,

$S$  = minimum tensile strength of the plate in tons per square inch, which should be between the limits of 26 and 35 tons per square inch,

$E$  = efficiency factor for the welded longitudinal seam, see Table 6, and equals 1 for a seamless unpierced shell,

$D$  = maximum internal diameter of the cylindrical portion of the shell in inches.

TABLE 6

Class	Tests and Heat Treatment Required	Efficiency Factor E
Class I	With weld tests, complete radiographic examination and with heat treatment	.90
Class II (a)	With weld tests and heat treatment	.80
(b)	With weld tests and without heat treatment	.75
Class III (a)	With weld tests and heat treatment	.70
(b)	With weld tests and without heat treatment	.65
(c)	Hydraulic test only	.60

### 292. Tube Plates

The working pressure on tube plates forming portions of cylindrical drums may be obtained from the formula in paragraph 243(g).

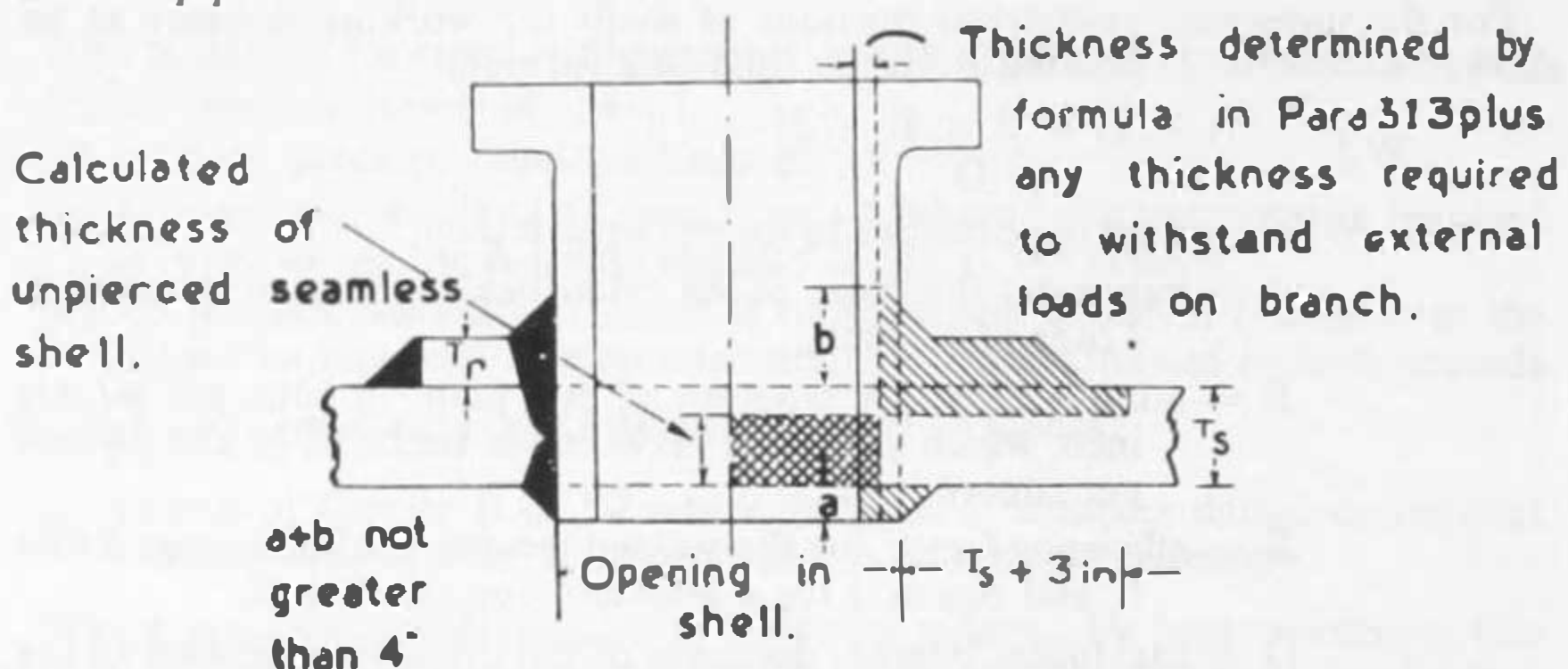
### 293. Compensation for Openings in Shells (see also paragraph 299)

(a) Manholes in cylindrical shells should have their shorter axes arranged longitudinally.

(b) Where the cylindrical shell is cut for an opening, the diameter of which exceeds  $2\frac{1}{2}$  times the required thickness of the shell plate plus  $2\frac{1}{2}$  inches, compensation must be provided and this should be such that the strength in way of the hole is not less than that of a seamless unpierced shell of similar material and diameter designed for a similar pressure.

(c) Where branches or standpipes are welded to cylindrical shells and compensation is required, the area to be compensated, area X in Fig 8, measured parallel to the longitudinal axis should not be greater than area of compensation, area Y.

(d) Due allowance should be made for any difference between the tensile strengths of the material of the shell and of the compensating rings, branches or standpipes.



Note :- Area  $y$  to be not less than area  $x$

FIG. 8

#### 294. Unstayed Dished End Plates (Concave to Pressure)

The working pressure on dished end plates, not exposed to flame and intended for pressure vessels of Class I may be calculated from the formulae given in paragraph 223. For typical methods of attachment see paragraph 296.

For end plates intended for pressure vessels other than boilers and dished to partially spherical form and not exposed to flame and intended for pressure vessels of Classes II and III, the working pressure may be calculated from the following formula:

$$W.P. = \frac{18 \times S \times t}{R}$$

Where W.P. = working pressure in lb. per square inch,

$S$  = minimum tensile strength of the end plate in tons per square inch,

$t$  = thickness of the end plate in 32nds of an inch,

$R$  = inside radius of curvature of the end in inches, which should not exceed the outside diameter of the flanged portion of the end.

The inside radius of the curvature at the flange, should not be less than four times the thickness of the end plate and in no case be less than 2.5 inches.

For ends which are butt welded to the shell, the thickness of the edge of the flange for connection to the shell should be not less than the required thickness of an unpierced shell.

#### 295. Unstayed Dished End Plates (Convex to Pressure)

The working pressure on end plates dished to partially spherical form (see Fig. 12 paragraph 296) may be calculated from the following formula:

$$W.P. = \frac{C \times S \times t}{R}$$

Where W.P. = working pressure in lb. per square inch,

$C$  = 12.0 for Classes II and III pressure vessels,

$S$  = minimum tensile strength of the plate in tons per square inch,

$t$  = minimum thickness in 32nds of an inch,

$R$  = inner radius of curvature of the end plate in inches which should not exceed the outside diameter of the flanged portion of the end.

The inside radius of curvature at the flange should not be less than four times the thickness of the end plate and in no case less than 2.5 inches.

296. *Typical Methods of Attaching Dished End Plates to Cylindrical Shells*

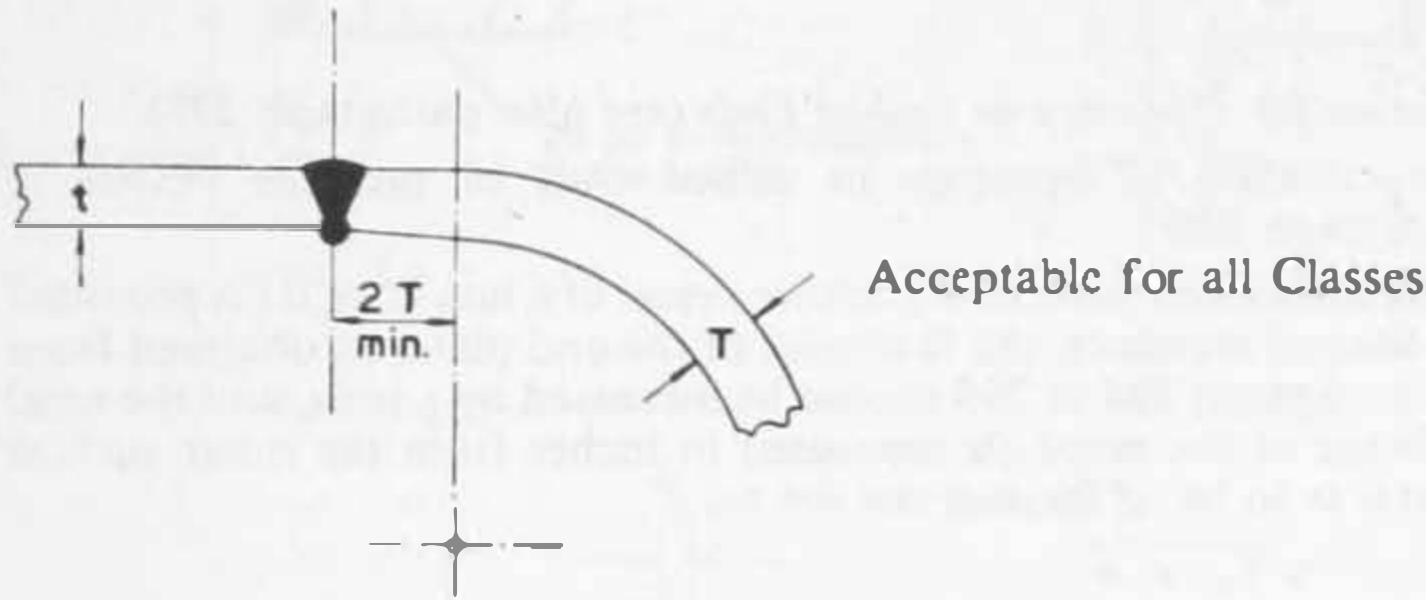


FIG. 9

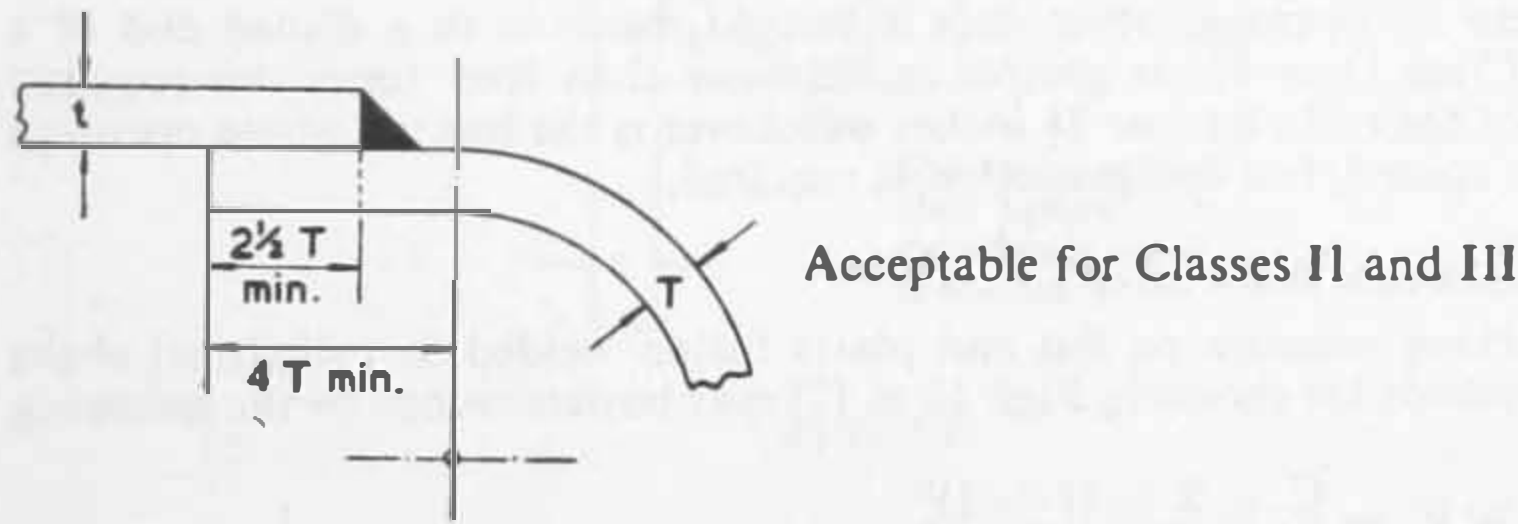


FIG. 10

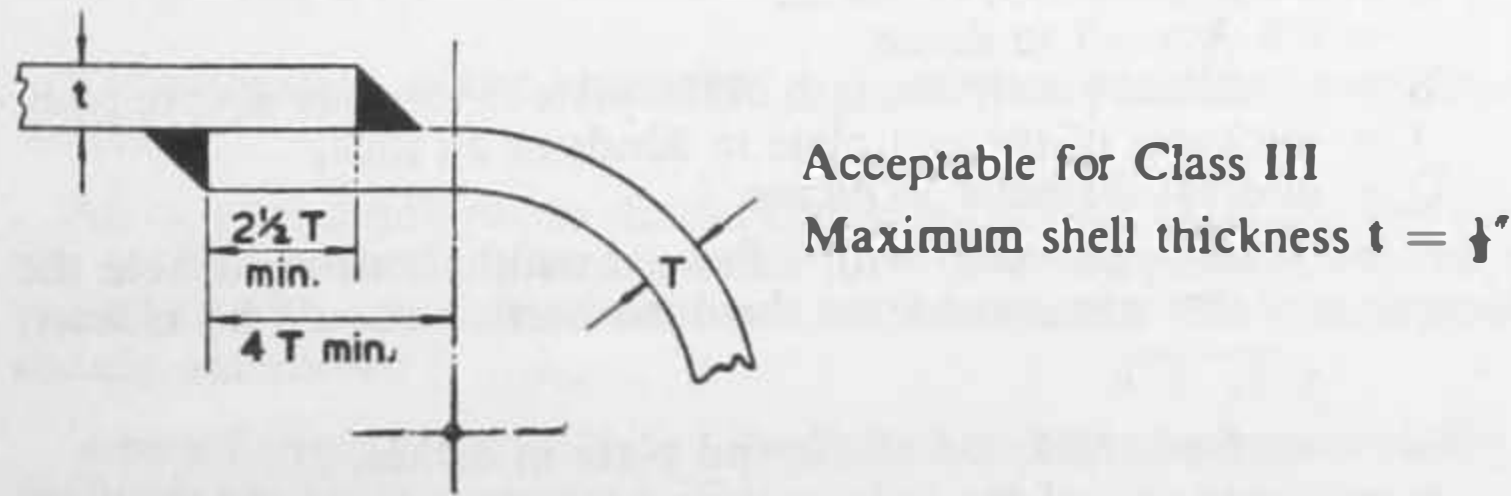


FIG. 11

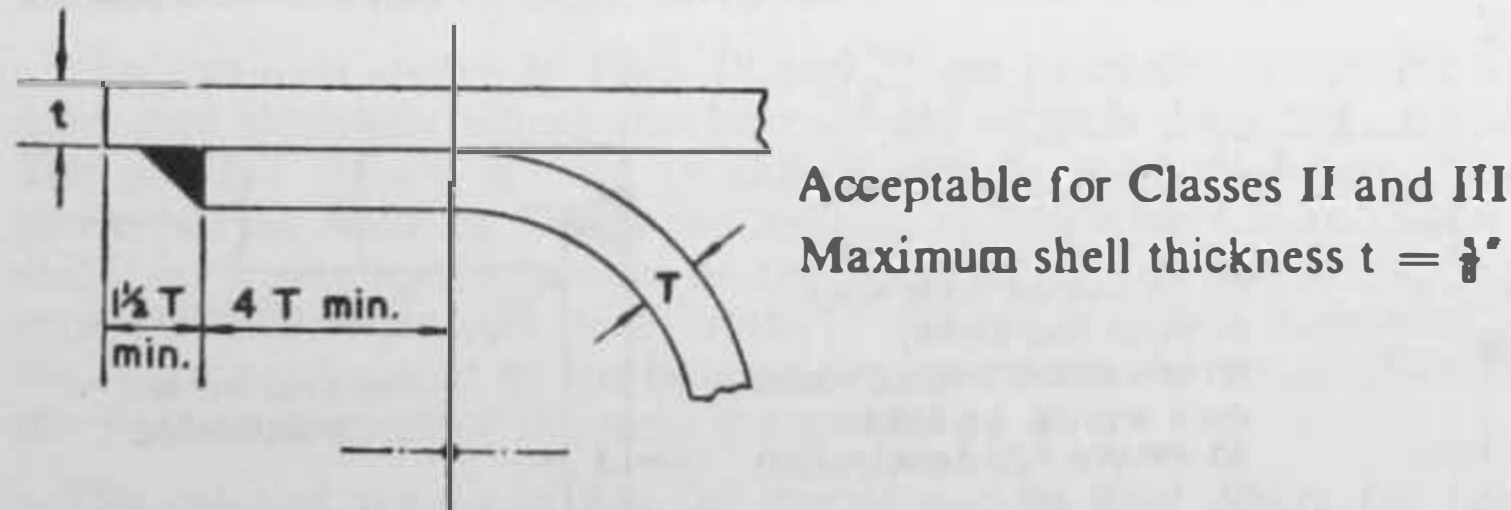


FIG. 12



Where the thickness of the end plate is greater than that of the cylindrical shell or vice versa the thicker plate should be gradually reduced in thickness to that of the thinner plate but in no case should the thickness of the plates at the seam be less than that required for an unpierced shell (see Fig. 9, also paragraph 223).

## 297. Compensation for Openings in Dished Ends (see also paragraph 299)

(a) For compensation of openings in dished ends of pressure vessels of Class I see paragraph 223.

(b) Where the dished end plate of a pressure vessel of Class II or III is provided with a central flanged manhole, the thickness of the end plate, as obtained from the formula in paragraph 294 or 295 should be increased by  $\frac{1}{8}$  inch, and the total depth of the flange of the manhole measured in inches from the outer surface at the minor axis is to be at least:

$$\sqrt{T_E \times w}$$

Where  $T_E$  = required thickness of the pierced dished end plate in inches,  
 $w$  = minor axis of the manhole in inches.

(c) Where an opening, other than a flanged manhole in a dished end of a vessel of Class II or III is greater in diameter than four times the required thickness of the end plate, or  $2\frac{1}{2}$  inches whichever is the less, or where openings are closely spaced, full compensation is required.

## 298. Unstayed Flat End Plates

The working pressure on flat end plates fusion welded to cylindrical shells (typical methods are shown in Figs. 13 to 17) may be determined by the following formula:

$$W.P. = \frac{C \times S \times (t - 1)^2}{D^2}$$

Where W.P. = working pressure in lb. per square inch,  
 $C$  = 3.8 not exposed to flame,  
 = 2.8 exposed to flame,  
 $S$  = minimum tensile strength of the plate in tons per square inch,  
 $t$  = thickness of the end plate in 32nds of an inch,  
 $D$  = internal diameter in inches,

Where a flat end plate is provided with a flanged manhole or sight hole the depth of flanging in inches measured from the outer surface should be at least:

$$\sqrt{T_E \times w}$$

Where  $T_E$  = required thickness of the end plate in inches,  
 $w$  = minor axis of the hole in inches.

Where the diameter of an unflanged hole in a flat end plate exceeds two and one-half times the required thickness of the plate +  $2\frac{3}{8}$ ", compensation should be provided.

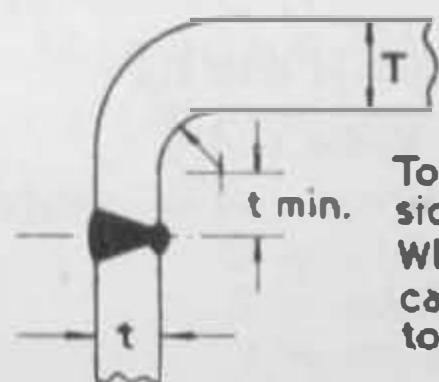


FIG. 13

To be welded from both sides of the plate. Where this is impracticable care should be taken to ensure full penetration

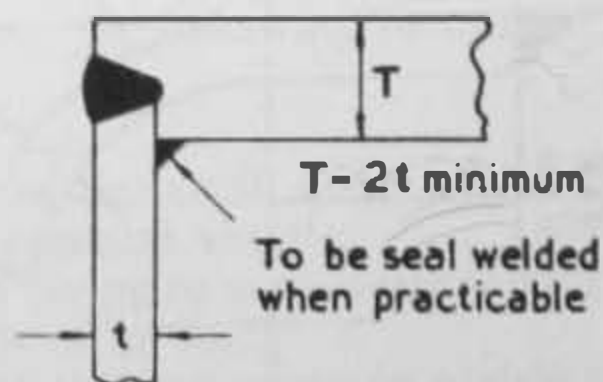


FIG. 14

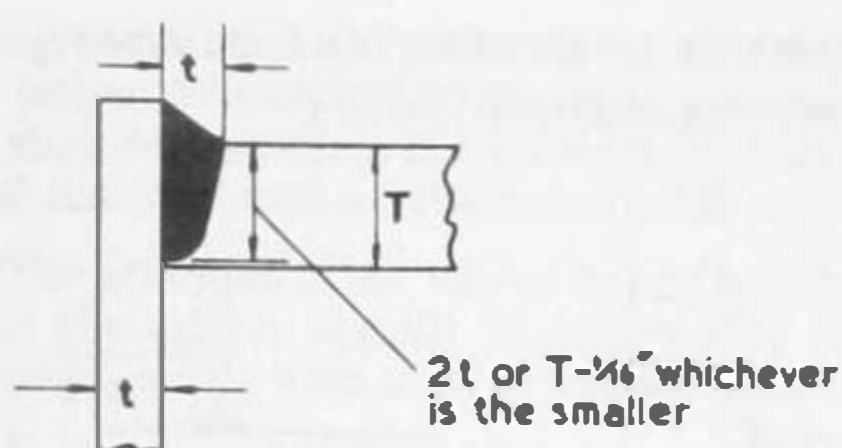


FIG. 15

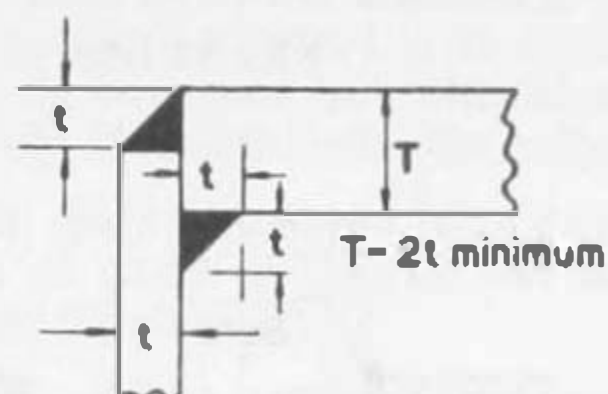


FIG. 16

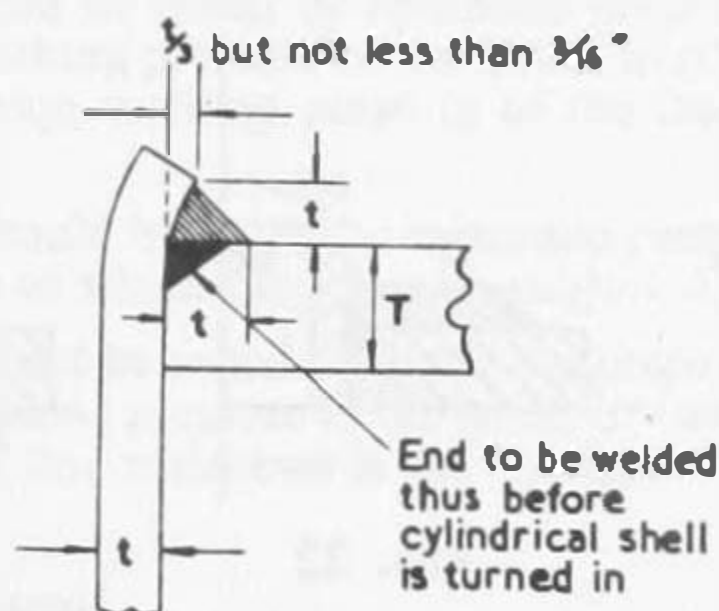


FIG. 17

## 299. Methods of Attaching Compensation Plates, Branches and Other Connections

Compensation plates, branches and other connections may be secured by welding.

All compensation plates should be bedded closely to the surface to which they are to be attached. Where necessary, welded compensation plates should be provided with a tell tale hole open to atmosphere. The diameter of this hole should not exceed  $\frac{3}{8}$  inch.

Where flanges are attached to the branches they may be secured by any of the methods shown in paragraph 314.

Typical methods of welding compensation plates, branches and other connections are shown in Figs. 18 to 26.

The methods shown in Figs. 18 and 21 are generally acceptable for shells of moderate thickness where the bore of the branch does not exceed 4 inches. The method shown in Fig. 19 should not be adopted where the interior is accessible for welding. When the method of attachment is as shown in Fig. 20 and it is impracticable to weld on the inside of the branch, the Surveyor should satisfy himself that full penetration is obtained, and it is recommended that backing rings be used or the bore of the branch machined after welding so that the bottom portion of the weld is removed.

The method shown in Fig. 26 should not be used where the bore exceeds 2 inches.

## TYPICAL METHODS OF WELDING COMPENSATING PLATES, BRANCHES AND OTHER CONNECTIONS

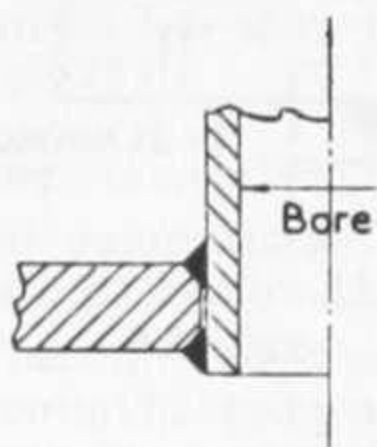


FIG. 18

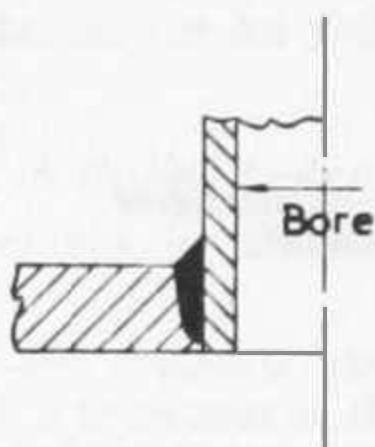


FIG. 19

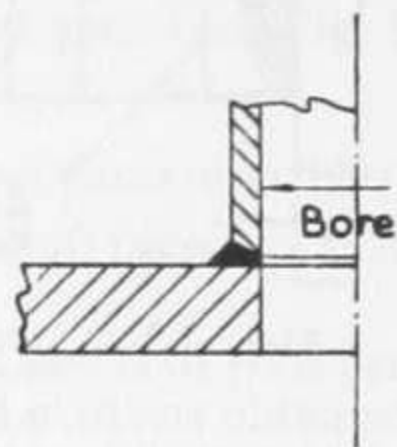


FIG. 20

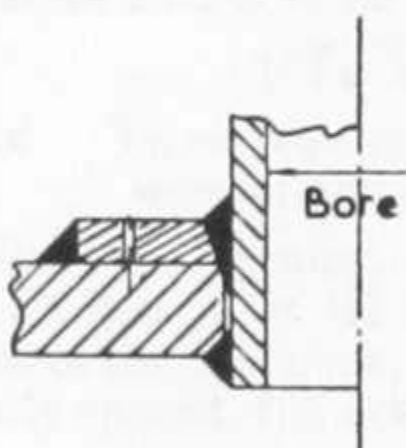


FIG. 21

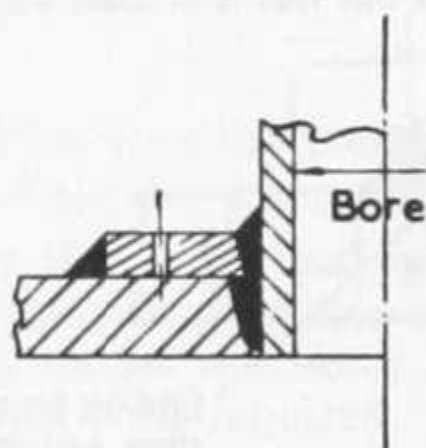


FIG. 22

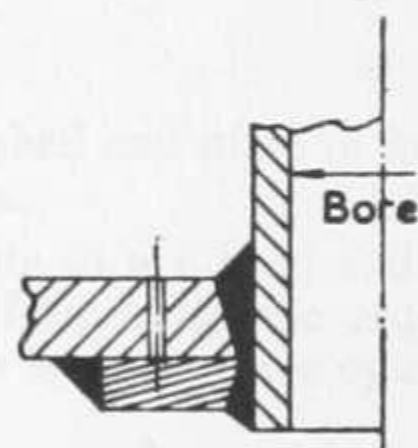


FIG. 23

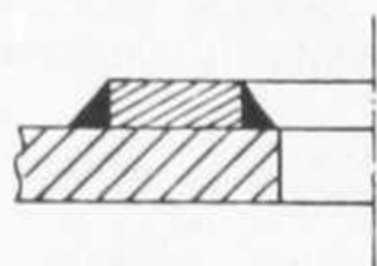


FIG. 24

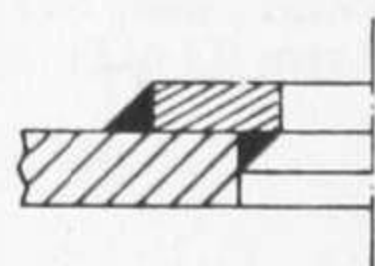


FIG. 25

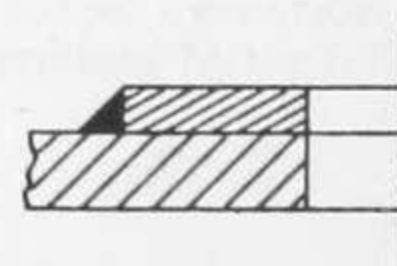


FIG. 26

### Chapter 6

## BOILER MOUNTINGS, STEAM AND FEED PIPE FITTINGS

### 300. *Material, Design and Hydraulic Test*

(a) Cast steel or other material accepted as equivalent should be used for boiler mountings of all sizes, for steam pipe fittings of  $2\frac{1}{2}$  inches bore and over and for all steam fittings subject to temperatures exceeding  $425^{\circ}\text{F}$ . but not exceeding  $900^{\circ}\text{F}$ . Bronze or gunmetal may be accepted for such parts for temperatures up to  $425^{\circ}\text{F}$ . Where the temperature exceeds  $900^{\circ}\text{F}$ . details of the proposed material should be submitted to the Engineer Surveyor-in-Chief.

Pipe fittings in low pressure steam, exhaust and bled steam pipe lines designed for working pressures not exceeding 100 lb. per square inch may ordinarily be of cast iron provided the steam temperature does not exceed  $425^{\circ}\text{F}$ .

(b) The necks of stop valve chests and other boiler mountings should be as short as practicable.

(c) Where boiler mountings are secured by studs, the studs should have a full thread holding in the plate for a length of at least one diameter. If the stud holes penetrate the whole thickness of the plate, the studs should be screwed through the plate and be fitted with nuts inside the boiler. Where bolts are used for



securing mountings they should be screwed through the plate from the inside of the boiler. Where boiler mountings of small bore are permitted to be attached to the shell by screwing, the screwed portion should be a good fit in the threaded part of the shell and a substantial back nut should be fitted inside the boiler.

(d) The spindles of all valves over  $1\frac{1}{2}$  inches in diameter should have outside screws; the covers should be secured by bolts or studs. All valves are to be arranged to shut with a clockwise motion of the handwheels.

(e) It is important that all valves and cocks should be provided with means for showing whether they are open or shut.

(f) All boiler mountings should be tested by hydraulic pressure to twice the maximum working pressure of the boiler, except that boiler mountings in the boiler feed system should be tested by hydraulic pressure to two and one-half times the maximum working pressure of the boiler to which they are connected or to twice the maximum working pressure of the feed line whichever is the greater.

Steam pipe fittings should be tested by hydraulic pressure to twice the maximum working pressure to which they may be subjected.

Feed pipe fittings should be tested by hydraulic pressure to two and one-half times the maximum working pressure of the boiler or twice the maximum working pressure of the feed line whichever is the greater.

### 301. *Safety Valves: General*

The designs of all safety valves should be submitted to the Engineer Surveyor-in-Chief for consideration unless they have been previously accepted as standard designs.

It is an offence under Section 433 of the Merchant Shipping Act, 1894, to place an undue weight on the safety valve of *any* steamship. Section 286 further prohibits any increase of the weight on the safety valve of a passenger steamer beyond the limit fixed by the Surveyor and should it at any time come to a Surveyor's knowledge that the loading of the valves has been altered or that the valves have been in any way interfered with, so as to increase the pressure without the sanction of the Ministry, he is at once to report the facts to headquarters.

When the Surveyor has determined the working pressure of the boilers and machinery he is to see the safety valves loaded accordingly and in such manner as to preclude the possibility of the load being increased. Therefore the springs, valves, spindles and adjusting screws should be so cased in that they cannot be tampered with and substantial locks should be used for locking up the safety valves. Any other part of a safety valve capable of adjustment to increase the load on the valve should be fitted with a substantial locking device.

### 302. *Minimum Number and Area of Safety Valves and Area of Passages*

(a) At least two safety valves should be fitted to each boiler.

(b) The minimum aggregate area of the locked-up safety valves should not be less than is obtained from the following formulae, but in no case should valves less than  $1\frac{1}{2}$  inches in diameter be passed without the sanction of headquarters.

(i) For Saturated Steam:

$$A = \frac{H \times E}{C \times P}$$

Where  $A$  = for ordinary, high lift, and improved high lift safety valves the aggregate area in square inches of the orifices through the seatings of the valves, and for full lift and full bore safety valves the nett area in square inches through the seats after deducting the area of guides or other obstructions when the valves are fully lifted,

$E$  = evaporation in lb. per square foot of heating surface  $H$  per hour with a minimum value of 6 for coal or oil fired boilers. For boilers heated by exhaust gas only, the makers figures for the maximum evaporation per square foot of heating surface may be taken. For composite boilers  $E$  may be modified accordingly,

$H$  = total heating surface in square feet to which factor  $E$  applies,

$P$  = working pressure of the safety valves in lb. per square inch absolute (i.e. working pressure + 15),

$C$  = 4.8 for ordinary spring loaded valves,  
= 7.2 for high lift spring loaded valves,  
= 9.6 for improved high lift spring loaded valves,  
= 19.2 for full lift valves,  
= 30.0 for full bore relay operated valves.

(ii) For Superheated Steam:

$$A_s = A \left( 1 + \frac{T_s}{1000} \right)$$

Where  $A_s$  = aggregate area of safety valves in square inches for superheated steam,

$A$  = aggregate area of safety valves in square inches as found from the formula in sub-paragraph (b)(i) above,

$T_s$  = superheat of steam in degrees F., i.e. superheat temperature minus saturated temperature.

(c) Where it is proposed to supply safety valves, the designs of which have not been previously accepted, the designs should be submitted to the Engineer Surveyor-in-Chief who will determine the coefficient  $C$  required by sub-paragraph (b)(i). It may be necessary for the maker to show by actual test that the valves are capable of passing the necessary quantity of steam.

(d) All the safety valves of each boiler may be fitted in one chest, which should be separate from any other valve chest. The valve chest should be connected directly to the boiler by a strong and stiff neck, the passage through which should have a cross sectional area at least equal to one half the aggregate area of the safety valves in the chest, except that, in the case of full lift safety valves the cross sectional area should be at least equal to the aggregate area of the safety valves in the chest. The arrangements of every boiler or other pressure vessel used for generating steam should be such that the escape of steam through the safety valves required by Section 285(4) of the Merchant Shipping Act, 1894 cannot be wholly or partially intercepted.

(e) Where a superheater can be shut off from the boiler it should be fitted with at least one safety valve not less in diameter than  $1\frac{1}{2}$  inches and fitted with easing gear. This should be additional to the safety valves required to be fitted on the boiler in accordance with sub-paragraphs (a) and (b) of this paragraph.

(f) With ordinary, high lift and improved high lift safety valves the openings for the passage of steam from the valves on a boiler, including the waste steam pipe, should have a cross sectional area at least 1.1 times the required aggregate area of the safety valves. With full lift safety valves with constant C not exceeding 19.2 the waste steam pipe and the openings for the passage of steam from the valves should have a cross sectional area at least twice the required aggregate area of the safety valves and three times that area where the valves are of the full bore type with a constant not exceeding 30. The cross sectional area of the discharge openings and discharge pipe from the safety valve on an economiser should be at least twice that of the valve. The area of any main waste steam pipe should not be less than the sum of the areas required for the branch pipes attached to it. Valve chests and waste steam pipes should be drained by a pipe fitted at the lowest part of the exhaust opening of each chest and led clear of the boiler, superheater or economiser. No cock or valve should be fitted on this pipe.

(g) Where silencers are fitted in the waste steam pipes, particulars, including the minimum clear area through the silencer which should not be less than that required for the waste steam pipe, and the makers estimate of the maximum pressure that could occur in the waste steam pipe between the safety valve and the silencer should be submitted to the Engineer Surveyor-in-Chief for consideration.

(h) Waste steam pipes should be designed to withstand the maximum pressure to which they may be subjected. They should be adequately supported and the arrangement should be such that no undue load falls on the safety valve branch.

### 303. *Details of Safety Valves*

(a) The clearance of the spindle, spring, etc., above the valve should be such as to permit a lift of at least one fourth the diameter of the valve.

(b) Valves and valve seats should be made of non-corrodible metal, and the valve seats should be effectively secured to the chests.

(c) Valve wings should have clearance in the seats of at least  $\frac{1}{8}$  inch on the diameter; valve stems should have sufficient clearance in the seats; valve wings or stems should not project through the seats.

(d) The construction of a safety valve should be such that the valve will be retained on the spindle and cannot lift out of its seat in the event of a spring breaking.

(e) Valve spindles, compression screws and the bushes in which they work should be made of non-corrodible metals. The clearance of the spindles in the bushes should be sufficient, and the bushes should be well secured. The washer fitted over the top of the spring should be suitably recessed and the end of the compression screw should be a good fit in the recess to ensure that the washer cannot come into contact with the valve spindle.

(f) The compression screw should abut against a metal stop or washer when the valve is loaded.

(g) Safety valves should be fitted with screw lifting gear so arranged that it can be operated easily by hand from an accessible place free from the danger of steam. The lifting gear should, where practicable, be arranged to lift all the safety valves on any one boiler together. The arrangement should, in general, permit the valves to be turned round on their seats by hand.



### 304. Springs of Safety Valves

(a) The size of the steel from which safety valve springs are made should be in accordance with the following formula, except that the diameter or side of the square should as a rule not be less than  $\frac{1}{8}$  inch:

$$d = \sqrt[3]{\frac{s \times D}{c}}$$

Where  $s$  = load on the spring in lb.,

$D$  = mean diameter of the spring in inches,

$d$  = diameter or side of square of the steel in inches,

$c$  = 8,000 for round steel,

= 11,000 for square steel.

(b) A spring should have a sufficient number of coils to require a compression under the working load of at least one quarter the diameter of the valve and the number of spring coils required for this compression is given approximately by the following formula:

$$N = \frac{K \times C \times d^4}{s \times D^3}$$

Where  $N$  = number of free coils in spring,

$K$  = compression in inches,

$d$  = diameter or side of square of the steel in sixteenths of an inch,

$C$  = 22 for round steel,

= 30 for square steel,

and  $s$  and  $D$  have meanings as before.

(c) The clearance between separate coils should not in general be less than  $\frac{1}{8}$  inch when the spring is loaded.

(d) Springs should be protected from the steam issuing from the valves.

### 305. Safety Valves to be Tested under Steam

(a) A Surveyor is not to give a declaration covering safety valves unless he has examined them and he is satisfied that they are in accordance with the accepted design, and that the area is not less than required by paragraph 302. He should see that the safety valves are set to their working pressures under steam. He should also see that when under steam they are free to lift the full amount appropriate to the type of valve.

(b) Except as stated in sub-paragraph (c), tests for accumulation of pressure are to be witnessed under full firing conditions with the feed water shut off and the stop valves closed except that steam for auxiliaries essential to the test may be taken from one boiler. During the test there should be no communication between two or more boilers under test at the same time. The test is to be continued for as long as the water supply in the boiler permits, but the duration of the test need not exceed 15 minutes for cylindrical boilers or 7 minutes for water tube boilers. The accumulation of pressure should not exceed 10 per cent. of the working pressure. If however, it is found in any particular case that the accumulation of pressure exceeds that figure, the Surveyor should withhold the declaration and report the full particulars to the Engineer Surveyor-in-Chief.

(c) When owners or builders of water tube boilers consider that an accumulation test might cause damage to the superheaters, applications to forego accumulation tests will be considered by the Engineer Surveyor-in-Chief. Such applications should be made when details of the boiler designs, evaporative capacity, and the safety valves and their positions are submitted.

(d) In the case of waste heat boilers heated by exhaust gases the accumulation test should be carried out with the feed water shut off, all stop valves closed and with the engines supplying the exhaust gas under maximum load conditions and, in the case of composite boilers the test should be under full firing conditions representing the most severe likely to arise in service.

(e) When witnessing safety valve tests, Surveyors should use the test pressure gauges supplied by the Ministry. No steam gauge should be used without having a syphon filled with water between it and the boiler.

### 306. *Stop Valves*

(a) Wherever a pipe is connected to a boiler, a valve or cock should, in general, be fitted between the boiler and the pipe.

(b) Where there are more water tube boilers than one and they are connected together, the main and auxiliary stop valves should be of the self closing or non-return type.

(c) To avoid piercing the boiler shell more than is necessary there should be as few auxiliary stop valves as possible. The arrangements, however, should be such that when more than one boiler is fitted it will be possible to supply the steam steering gear, steam whistle and steam driven electric generators from at least two boilers.

### 307. *Water Level Indicators*

(a) Every boiler should have at least two independent means of indicating the water level, one of which should be a glass water gauge, and the other an additional glass water gauge or other accepted water level indicator.

In new boilers test cocks should not be accepted except as provided for in sub-paragraph (b).

(b) In the case of boilers having an internal diameter less than 6 feet and having a working pressure less than 120 lb. per square inch, a set of not less than two test cocks fitted directly to the boiler shell may be accepted as one of the required water level indicators.

(c) Single-ended boilers should have the two water level indicators fitted, one on each side of the boiler.

(d) Double-ended boilers should have four water level indicators fitted, one indicator being positioned on each side of each end of the boiler.

(e) In the case of cylindrical boilers the level of the highest part of the combustion chamber or heating surface should be permanently marked in a position easily seen at all times and adjacent to the water level indicators.

(f) Where stand pillars or columns are connected to a cylindrical boiler by means of pipes, these pipes should be of copper or other non-corrodible metal and fitted with terminal cocks at the boiler shell. For boilers over 10 feet in diameter the pillars should be not less than  $2\frac{1}{2}$  inches and the connecting pipes not less than  $1\frac{1}{2}$  inches in internal diameter. For boilers exceeding 7 feet 6 inches but not exceeding 10 feet in diameter, the pillars should be not less than 2 inches and the connecting pipes not less than  $1\frac{1}{4}$  inches in internal diameter, and for boilers 7 feet 6 inches in diameter and under, the pillars should be not less than  $1\frac{1}{4}$  inches and the connecting pipes not less than 1 inch in internal diameter.

The upper ends of the pipes should be so arranged that there is no pocket or bend in which water can lodge. The pipes should not pass through uptakes, but, if this condition cannot be complied with, they may pass through the uptakes by a passage open for ventilation and at least 2 inches clear of the pipes all round.

(g) In the case of water tube boilers where water and steam drums exceeding 13 feet in length are fitted athwartship a water level indicator should be fitted near each end of the drum.

(h) The position of the water level indicators of water tube boilers in which the tubes are entirely drowned when cold is to be such that the water is just showing in the indicator when the water level in the steam drum is just above the top of the uppermost tubes when the boiler is cold. In boilers, the tubes of which are not entirely drowned when the boiler is cold, the water level indicators are to be placed, to the Surveyors satisfaction, in positions which have been found by experience to indicate satisfactorily that the water content is sufficient for safety under all service conditions.

(j) Surveyors are to satisfy themselves by actual examination that the water level indicators of the boilers of the vessels they survey are clear. In all cases where it is proposed to provide automatic valves or devices in water level indicators, full particulars are to be submitted to the Engineer Surveyor-in-Chief for consideration.

### *308. Blow Down Valves*

Each boiler should have a blow down valve fitted directly to the lower part.

Blow down valves, and scum valves when fitted, of two or more boilers may be connected to one common discharge but when so arranged there should be screw down non-return valves fitted for each boiler to prevent the contents of one boiler passing to another.

The blow down cock or valve on the ship's side should be fitted in an accessible position and provided with means for showing whether the cock or valve is open or shut. When a cock is fitted the handle should not be capable of being removed unless the cock is shut and if a valve is fitted the wheel must be fixed to the spindle.

### *309. Salinometer Cocks or Valves*

A salinometer cock or valve should be fitted directly to each boiler in a convenient position. It must not be on a water gauge stand pipe or pillar.

### *310. Pressure Gauges*

Each boiler should have a separate steam pressure gauge placed where it can be easily seen; double-ended boilers should have a pressure gauge at each end similarly placed. In the case of water tube boilers a pressure gauge should be connected to the saturated steam drum.

### *311. Boiler Feed Arrangements*

(a) Every boiler should have at least two efficient and separate feed systems, each with its own check valve. Check valve chests should in general be attached directly to the boiler with a stop valve fitted in each chest or between each chest and the boiler, so that either of the feed systems may be examined while the other feed system is in operation.

(b) In water tube boilers at least one of the feed systems should be fitted with an accepted apparatus whereby the feed supply is controlled automatically. The feed check valves should, where necessary, be fitted with efficient gearing whereby they can be controlled from the boiler room floor or other convenient position.

(c) Feed pumps should be reserved for feeding the boilers and the arrangements for supplying feed water should, if necessary, provide for the interception of oil in the feed water.

(d) Feed pipes should comply with the requirements of paragraphs 312 to 315. Feed water heaters, filters and fittings between the pumps and the boilers should be constructed for a working pressure of 25 per cent. in excess of the boiler pressure or for the maximum pressure to which the feed line may be subjected



in service, whichever is the greater; see paragraph 325 for hydraulic tests. An efficient relief valve or valves, suitably adjusted and of a type which cannot be readily overloaded, should be fitted where necessary to prevent overpressure in any part of the feed system under conditions likely to occur in service.

(e) In ships fitted with closed feed systems means should be provided for automatically shutting off steam from the main engines before overpressure occurs in the condenser.

## Chapter 7

### PRESSURE PIPES

#### 312. Copper Pipes

(a) Copper pipes should not be used for temperatures above 425°F.

(b) Steam pipes intended for working pressures over 180 lb. per square inch should not be of copper where the external diameter exceeds 5 inches.

(c) Copper pipes subject to working pressures over 75 lb. per square inch should be seamless.

(d) The working pressure allowed on copper pipes should be determined by the following formula:

$$W.P. = \frac{(t - 3) \times F}{D}$$

Where W.P. = working pressure in lb. per square inch for steam and air pipes, and boiler pressure for feed pipes,

D = external diameter in inches,

t = thickness in 100ths of an inch,

F = 70 for seamless steam and air pipes,  
48 for brazed steam pipes,  
56 for seamless feed pipes,  
38 for brazed feed pipes.

(e) Where copper pipes are to be bent they should be made thicker to provide for thinning at the bend. In no case should the radius of curvature at the centre line of the pipe be less than twice the external diameter of the pipe.

(f) Copper pipes should be annealed on completion and prior to testing by hydraulic pressure.

#### 313. Steel Pipes

(a) Pressure pipes for temperatures not exceeding 850°F. may be made of steel provided the material complies with the requirements of paragraphs 206 to 208.

(b) Where it is proposed to make the pipes of alloy steel for temperatures in excess of 850°F. full details should be submitted to the Engineer Surveyor-in-Chief for consideration.

(c) Steam pipes for pressures above 250 lb. per square inch, feed pipes, air pipes and pipes for conveying oil under pressure should be of seamless or other accepted construction. Other pipes may be lap welded by a mechanical process.

The working pressure allowed on seamless steel pipes, cold or hot finished, shall be determined by the following formula:

$$W.P. = \frac{(t - C_1) \times 161 \times C}{D}$$

The working pressure allowed on lap welded pipes shall be determined by the following formula:

$$W.P. = \frac{\left(\frac{t}{1.5} - 8\right) \times 161}{D}$$

Where W.P. = Working pressure in lb. per square inch for steam, air and oil pipes; for feed pipes W.P. is to be taken as 1.25 times the maximum boiler pressure but not less than the maximum pressure that can be developed in the feed line under service conditions.

D = external diameter in inches,

t = thickness in 100ths of an inch,

C<sub>1</sub> = 8 for steam and feed pipes for pressures up to and including 250 lb. per square inch,

= 6 for steam and feed pipes for pressures over 250 lb. per square inch and for all other seamless pipes,

C = a figure dependent upon the type of steel used and the steam temperature and obtained from the following table for the types of carbon and alloy steels specified. Values of C for temperatures between those shown may be found by interpolation. Values of C for other steels will be specially considered.

Type of Steel	Minimum tensile strength TONS per sq. inch	Steam temperatures °F.						
		650	700	750	800	850	900	950
		Values of C						
Carbon	23	1.0	0.95	0.89	0.82	0.73	—	—
½ % Mo.	28	1.19	1.19	1.19	1.18	1.15	1.05	0.69
1 % Cr. ½ % Mo.	27	1.15	1.15	1.15	1.15	1.13	1.07	0.75

A manufacturing tolerance not exceeding minus 15 per cent. may be allowed on the pipe thickness obtained from the above formulae.

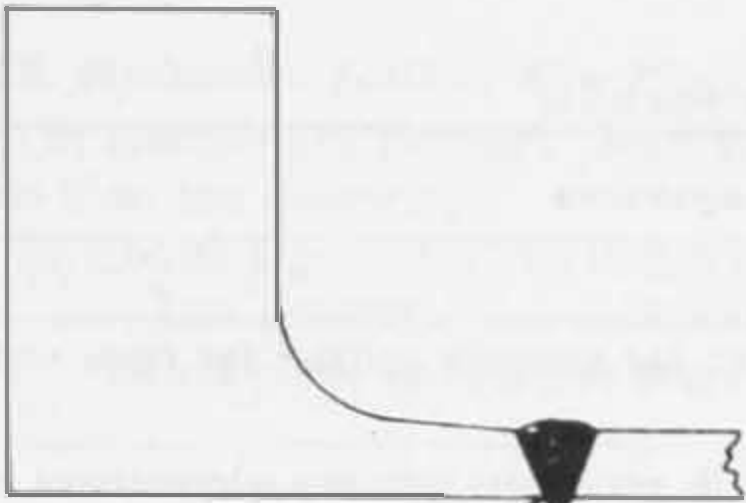
(d) Completed carbon steel pipes for pressures above 150 lb. per square inch or temperatures above 500° F. which have been heated during manipulation or have been strength welded should be suitably stress relieved before testing by hydraulic pressure. Where screwed and expanded flanges are fitted, with or without seal welding, any necessary stress relieving of the pipes should be carried out before the flanges are fitted. All alloy steel pipes which have been subjected to heating, bending or welding should be suitably heat treated. Details of the heat treatment proposed should be submitted to the Engineer Surveyor-in-Chief for consideration.

### 314. Methods of securing Flanges to Steel Pipes

(a) Flanges may be secured to steel pipes by strength welding or by screwing and expanding as shown in Figs. 1 to 7 and under the conditions given in the Table.

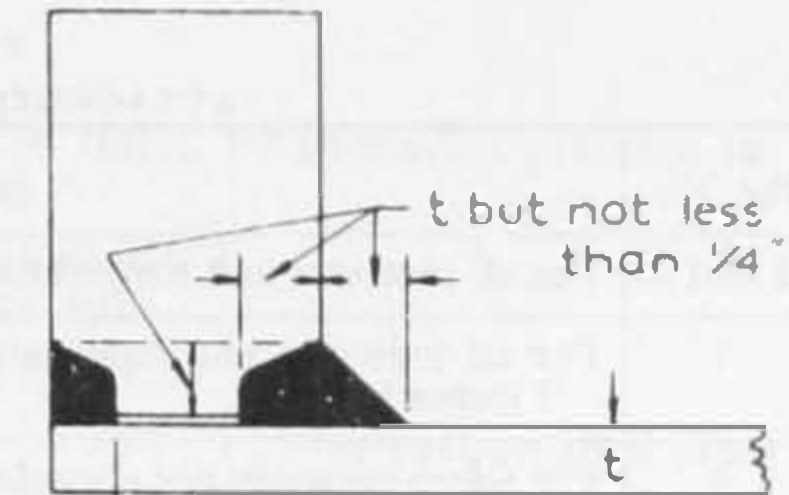
(b) Where flanges are secured by screwing and expanding, the pipe and flange are to be screwed with a taper or vanishing thread. The vanishing portion of the thread should be not less than three pitches in length. After the flange has been screwed well home the pipe should be expanded and a scaling weld may be applied.

TYPICAL METHODS OF ATTACHMENT OF FLANGES



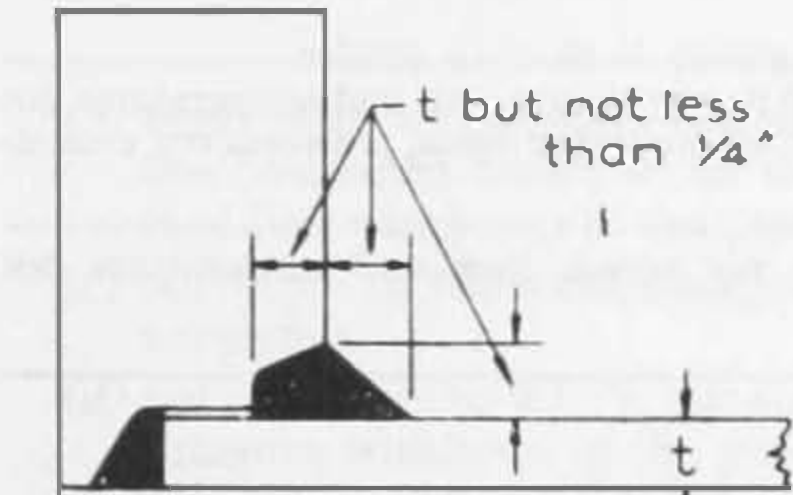
Internal run

FIG. No. 1



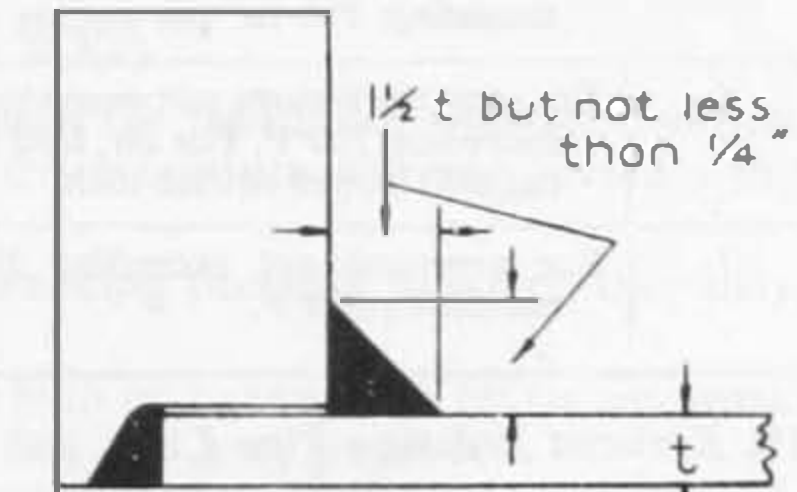
t but not less than 3/16"

FIG. No. 2



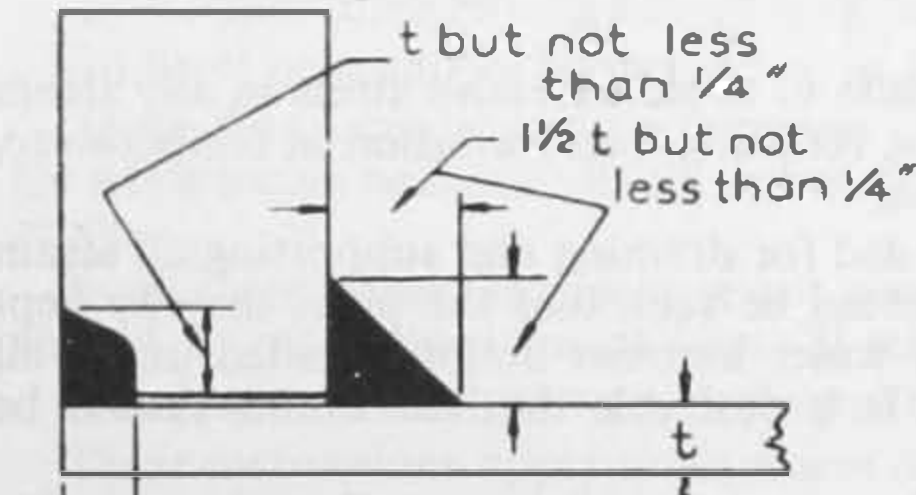
t but not less than 1/4"  
1/2 but not less than 3/16"

FIG. No. 3



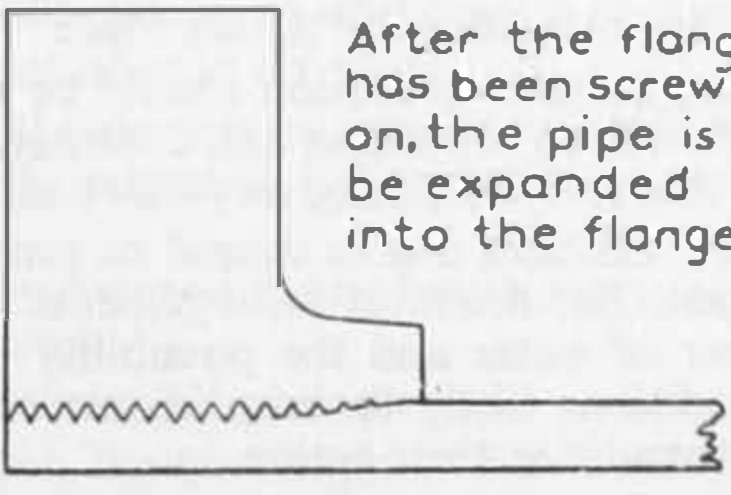
t but not less than 1/4"  
1/2 but not less than 3/16"

FIG. No. 4



t but not less than 3/16"

FIG. No. 5



Light sealing welds may be made at the face or the back of the flange

FIG. No. 6

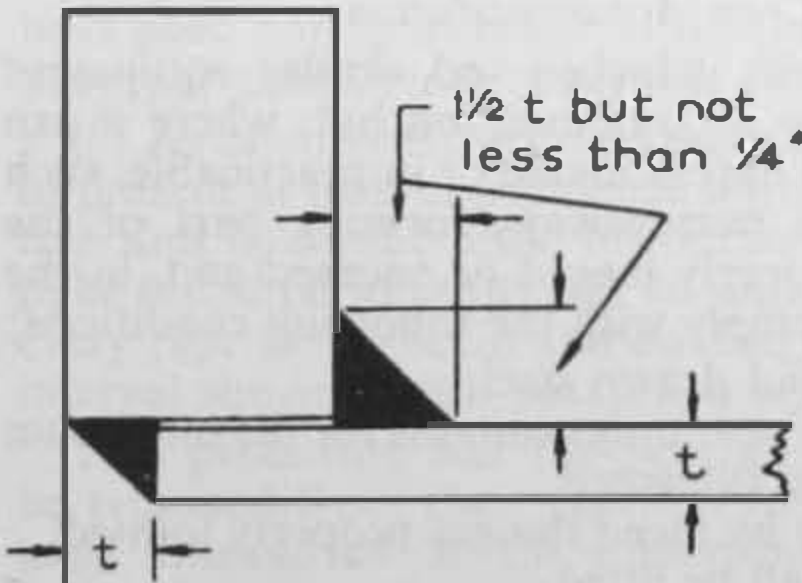


FIG. No. 7



TABLE  
ATTACHMENT OF FLANGES

Fig. No.	Service conditions
1 and 2	For all pressures and temperatures.
3	For all pressures and temperatures but not generally suitable for pipes under 3 inches bore.
4	For steam pressures not exceeding 550 lb. per square inch and temperatures not exceeding 750°F. but not generally suitable for pipes under 3 inches bore. For air, feed water, oil and other fluids, pressures not exceeding 750 lb. per square inch.
5	For steam pressures not exceeding 550 lb. per square inch and temperatures not exceeding 750°F. For air, feed water, oil and other fluids, pressures not exceeding 750 lb. per square inch.
6	For steam pressures not exceeding 450 lb. per square inch and temperatures not exceeding 750°F. For air, feed water, oil and other fluids, pressures not exceeding 600 lb. per square inch.
7	For pressures not exceeding 250 lb. per square inch and temperatures not exceeding 500°F.

### 315. *Reduced Pressure Pipe Lines*

Where a pressure pipe or fitting receives steam or air from any source at a higher pressure than that for which the pipe or fitting is designed an efficient reducing valve should be fitted. An efficient relief valve of sufficient size together with a pressure gauge should be fitted on the low pressure side of the reducing valve.

### 316. *Installation of Steam Pipes*

(a) Suitable provision should be made to avoid excessive stress in any steam pipe due to expansion and contraction resulting from variation in temperature, or due to vibration or any other cause.

(b) Efficient means should be provided for draining and supporting all steam pipes. The drainage arrangements should be such that the pipes may be kept clear of water and the possibility of water hammer action avoided under all conditions likely to arise in service. It is desirable that the drains should be automatic in their action.

(c) Special attention is called to the danger of allowing water to collect in branches of main or auxiliary steam pipes connecting these ranges, while under steam, with the stop valves of a boiler which is not in use. It is strongly recommended that isolating stop valves should be fitted where branch pipes from boilers join main and auxiliary ranges.

### 317. *Steam Pipes in way of Passenger and Crew Accommodation*

Steam and exhaust pipes to steering gear, winches and similar equipment should not pass through passenger or crew accommodation but, where it can be shown that alternative arrangements are unreasonable or impracticable, such pipes may be permitted to pass through passageways forming part of the accommodation provided the pipes are properly lagged or encased and, in the case of the steam supply pipes, that they comply with the following conditions:

- (i) The pipes shall be constructed of solid drawn steel.
- (ii) The pipes and their flanges shall be of scantlings suitable for the maximum steam pressure to which they may be subjected.
- (iii) All connections in the pipes shall be by faced flanges properly jointed.
- (iv) Adequate drainage arrangements shall be fitted.

### 318. Hydraulic Tests of New Pipes

On completion pressure pipes are to be tested by hydraulic pressure to not less than the following:

(a) Steam pipes working at not more than 650°F.:

Test pressure = 2 × working pressure

Steam pipes working at more than 650°F.:

$$\text{Test pressure} = 2 \times \text{working pressure} \times \begin{cases} \frac{1}{C} & \text{for carbon steel pipes} \\ \frac{1.19}{C} & \text{for } \frac{1}{2}\% \text{ Mo. steel pipes} \\ \frac{1.15}{C} & \text{for } 1\% \text{ Cr } \frac{1}{2}\% \text{ Mo. steel pipes} \end{cases}$$

where C is as in paragraph 313(c).

(b) Feed pipes to two and one-half times the maximum working pressure of the connected boiler or to twice the maximum working pressure in the feed line whichever is the greater.

(c) Air pipes to twice the maximum working pressure to which they may be subjected.

(d) Oil fuel pipes to 400 lb. per square inch or to twice the maximum working pressure whichever is the greater. See also paragraph 366.

### 319. Periodic Tests and Inspections of Steam Pipes

(a) Steam pipes should have the lagging removed and be examined and tested by hydraulic pressure to twice the maximum pressure to which they may be subjected, at the following intervals:

(i) Copper pipes having brazed longitudinal seams, at least once in four years.

(ii) Steel or seamless copper pipes, at least once in six years.

At the first periodic test the Surveyor need only require the removal of lagging for a few inches near each flange unless, in his judgment, it is necessary to remove more.

In all cases where the pipes are not wholly stripped the hydraulic test pressure should be maintained for at least 20 minutes.

It is recommended that copper pipes be annealed periodically.

These instructions apply to all steam pipes, the bursting of which would give rise to a risk of serious injury, but Surveyors need not test small pipes, from which the free outflow of steam would not entail such a risk. As the diameter, working pressure and situation of the steam pipes in the ship all have some bearing on risk of injury should a pipe burst, the Surveyor should use his judgment when deciding which steam pipes should be tested. Generally where the pressure does not exceed 250 lb per square inch, pipes of less than 3½ inches bore need not be included in the periodic tests unless in any particular case the Surveyor considers it desirable to do so.

(b) As an alternative to testing all the pipes at one time, owners may arrange to present at their convenience selected pipes or sections of pipe lines for inspection and hydraulic tests, on the understanding that all pipes that are required to be tested periodically will be similarly examined and tested in rotation so that every pipe in the main and auxiliary ranges will be examined and tested at the interval shown in sub-paragraph (a) (i) and (ii).

This procedure has the practical advantage that such pipes will normally be removed from their position for purposes of testing and Surveyors should avail themselves of the opportunity thus afforded for making a thorough internal examination of pipes open to inspection.

It will be necessary to keep records of steam pipes tested on this "running survey" principle, to ensure that all pipes are tested within their specified period. The appropriate entries should be made in the declaration with the words "running survey" added.

(c) When an existing ship is surveyed for a British passenger certificate for the first time, all steam pipes should be tested as indicated in paragraph 318.

(d) Notwithstanding the foregoing the Surveyor may require any steam pipe to be tested by hydraulic pressure or removed for internal examination if he has any reason to doubt its condition at any time.

(e) In all cases in which defects are found which require the repair or renewal of any of the steam pipes referred to in the foregoing paragraphs full details should be forwarded to the Engineer Surveyor-in-Chief for recording.

## Chapter 8

### EVAPORATORS, HEATERS, FILTERS, ETC.

#### 320. Material and Design

(a) Evaporators in which the main body is a single casting may have a working pressure not exceeding 15 lb. per square inch, and in general cast iron should not be used for the shells of evaporators where the working pressure exceeds 30 lb. per square inch.

Subject to these limitations evaporators made of cast iron, bronze or gunmetal having a tensile strength of not less than 10 tons per square inch, or of cast steel, may be allowed a working pressure not exceeding that found by the formulae in paragraph 321.

(b) Cast iron, bronze or gunmetal may be accepted where the working temperature does not exceed 425°F.

(c) Where parts of evaporators, steam generators, heaters, filters, etc. are of riveted or fusion welded construction they should comply with the relevant requirements for boilers or fusion welded pressure vessels.

(d) For feed heaters, etc. see paragraph 311(d) and for oil fuel heaters, etc. see paragraphs 365(c) and 366.

#### 321. Working Pressure of Cast Vessels Subject to Internal Pressure

(a) The pressure allowed on cast pressure vessels should not exceed that obtained from the following formulae:

(i) Cylindrical Shells 
$$W.P. = \frac{C(T - \frac{1}{2})}{D}$$

(ii) Circular Flat Surfaces 
$$W.P. = \frac{C_1 \times T^2}{D^2}$$

(iii) Square Flat Surfaces 
$$W.P. = \frac{C_2 \times T^2}{S^2}$$

Where W.P. = working pressure in lb. per square inch,

T = thickness of the casting in inches,

D = internal diameter in inches; for covers, the diameter of the pitch circle of the bolts,

S = length of side of the flat surface in inches.

Constant (See Note)	Cast Iron	Bronze or Gunmetal	Cast Steel
C	4,000	6,000	10,400
C <sub>1</sub>	24,000	30,000	52,000
C <sub>2</sub>	16,000	20,000	34,700

NOTE. In vessels subject to water pressure only the constants may be increased by 25 percent.



Except for very small castings the thickness of the material should not be less than the following:

Internal Diameter	Thickness in inches		
	Cast Iron	Bronze or Gunmetal	Cast Steel
Over 12 inches	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{1}{2}$
Up to and including 12 inches	$\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{4}$

(b) Where there are large branches, doors or other openings in the castings the scantlings will require to be materially increased and provision should also be made at the necks of branches and other parts to resist stresses not directly due to the internal pressure.

322. *Stress Allowed on Studs, etc.*

In calculating the strength of studs or bolts securing the covers of evaporators, feed heaters, feed filters, and other similar vessels, the stress allowed on the net section of the material of steel studs, etc., should not exceed 9,000 lb. per square inch when the diameter is  $\frac{3}{8}$  inch, or more. When the diameter is less than  $\frac{3}{8}$  inch, the stress allowed per square inch of net section should not exceed 7,200 lb. per square inch

Studs or bolts securing covers which are required to be frequently removed should not be less than  $\frac{3}{8}$  inch in diameter.

323. *Mountings*

(a) The mountings for evaporators and steam generators should, in general, be similar to those required for boilers. A single safety valve, however, may be allowed for evaporators, provided that it is of sufficient size and the reduced orifice, see sub-paragraph (b), is not greater than would be allowed for the same pressures, with a single valve  $2\frac{1}{8}$  inches in diameter.

(b) The steam inlet to the coils should have an orifice of a diameter not exceeding that found by the following formula:

$$d = D \sqrt{\frac{n \times p}{6 \times P}}$$

- Where d = diameter of orifice in inches,  
D = diameter of safety valves in inches,  
n = number of safety valves on evaporator,  
p = absolute pressure at which the evaporator is worked,  
P = absolute pressure of the entering steam.

Where a reducing orifice is necessary to effect a reduction of area, it should be bored through non-corrodible metal, and should be parallel for a length of at least  $\frac{1}{2}$  inch; every nozzle should be formed with a facing at the side, on which particulars regarding the safety valves, their load, the maximum pressure of the entering steam, and the diameter of the orifice should be stamped, as shown by the following example:

2 S.V. DIAM. 3". LOAD 10 lb. sq. in.  
STEAM PRESS. 160 lb.  
REDUCED ORIFICE  $\frac{3}{4}$ " DIA.

(c) Where baffle or dash plates are fitted below the steam domes of evaporators, they should be easily removable for inspection of the dome.

(d) The spring-loaded safety valves should be set to the working pressure and tested for accumulation, in accordance with the requirements of paragraph 305. The test should be continued for a period of five minutes under conditions of maximum evaporation with all other outlets closed; the accumulation of pressure should not exceed 10 per cent. of the working pressure.

### 324. Distilling Apparatus

Steam for working distilling apparatus for drinking water is not to be taken from main or auxiliary boilers, but is to be taken from an evaporator or a boiler designed for the purpose and in which boiler water treatment additives, zinc, etc., harmful in drinking water, are not used. The evaporator or boiler used with distilling plant should not be filled or fed with water from main or auxiliary condensers. Surfaces or parts made of copper in contact with steam or drinking water should be tinned.

A distilling apparatus for drinking water should have a filter containing at least 20 cubic inches of animal charcoal and 20 cubic inches of gravel or limestone chips for every 100 gallons of the output in 24 hours for which the distiller is passed.

Suitable relief valves should, if necessary, be fitted on the steam and water sides of all distilling apparatus to prevent overpressure in any part of the system.

### 325. Hydraulic Tests

(a) All new evaporators, steam generators, heaters, filters, etc. should be tested by hydraulic pressure as follows:

Description	Hydraulic Test in lb. per square inch
Cast evaporators, heaters, etc. not subject to feed or oil fuel pressure	$2 \times \text{W.P.}$
Welded or riveted evaporators, steam generators, heaters, etc. not subject to feed or oil fuel pressure	$2 \times \text{W.P.}$ where W.P. is 100 lb. per sq. inch or less $1\frac{1}{2} \times \text{W.P.} + 50$ where W.P. exceeds 100 lb. per square inch
Cast or welded heaters, etc. subject to feed pressure	$2\frac{1}{2} \times \text{W.P.}$ of boiler or $2 \times \text{W.P.}$ of feed line whichever is greater
Cast or welded heaters, etc. subject to oil fuel pressure	$2 \times \text{W.P.}$ or 400 lb. per sq. inch whichever is greater*
Coils or tubes of evaporators, etc. not subject to feed or oil fuel pressure	$2 \times \text{W.P.}$
Coils or tubes of heaters, etc. subject to feed pressure	$2\frac{1}{2} \times \text{W.P.}$ of boiler or $2 \times \text{W.P.}$ of feed line whichever is greater
Coils or tubes of heaters, etc. subject to oil fuel pressure	$2 \times \text{W.P.}$ or 400 lb. per sq. inch whichever is greater*

Where W.P. = maximum working pressure.

\* See paragraphs 365(a) and 366.

(b) On completion of the hydraulic tests the apparatus should be stamped, in a conspicuous place preferably on the dressed edge of a flange, with the letters M.T., the test pressure applied to the shell, the test pressure applied to the coils (or tubes) if any, the date and the Surveyors initials.

## Chapter 9

### SHAFTING

#### 326. Material

(a) Ingot steel for shafts should, in general, have a tensile strength of 28 to 32 tons per square inch and should comply with the requirements of paragraphs 194 to 197.

(b) Couplings of ingot steel shafts should be forged from the solid shaft or may be formed by upsetting the ends by hydraulic pressure. Couplings, when separate from the shaft, may be forged from ingot steel or they may be steel castings.

(c) Coupling bolts should be of ingot steel and in general should have a tensile strength of 28 to 32 tons per square inch. The material should comply generally with the requirements of paragraphs 194 to 197; the makers' guarantee regarding the quality of the material may be accepted.

(d) The webs of built crank shafts may be forged or rolled from ingot steel or they may be steel castings (see paragraphs 194 to 197 for ingot steel and 202 to 205 for castings).

Forged crank webs may be flame cut from the slab provided that about  $\frac{1}{4}$  inch of material is afterwards removed by machine from around the crank pin and journal holes and the outer edges of the webs are dressed smooth.

(e) Bronze for intermediate and propeller shafts should comply with the requirements of paragraph 210.

(f) Where it is proposed to use material other than that referred to above, the case should be submitted to the Engineer Surveyor-in-Chief.

#### 327. Shafting driven by Steam Turbines or Electric Propulsion Motors

(a) Intermediate shafts of turbine driven and electrically driven installations should have diameters not less than are given by the following formula:

$$d = \sqrt[3]{\frac{\text{S.H.P.} \times F}{R}}$$

Where  $d$  = diameter of the intermediate shaft in inches,

S.H.P. = maximum designed horse power transmitted by the shaft,

$R$  = revolutions per minute at that power,

$F$  = 55 for passenger ships of Classes I, II and IIA,

= 50 for passenger ships of Classes III, IV, V, VI and VIA.

For the shafting of turbine driven auxiliary generator units and for the turbine driven shafting of turbo-electric propulsion units,  $F$  may be taken as 50 for all classes of ships.

(b) Main wheel shafts of geared turbine-driven installations should not be less than  $1.1 \times d$  in diameter, but where there is only one pinion gearing into the wheel, or where there are two or more pinions gearing into the wheel and the centres of all the pinions fall within an angle of less than  $120^\circ$ , the diameter of the wheel shaft at the wheel and the adjacent journals should not be less than  $1.16 \times d$ . Aft the journals the shaft may be gradually tapered down to the diameter required for the intermediate shaft.

(c) In adopting the diameter given by the formula given in sub-paragraph (a) builders should be satisfied from their examination of the shafting system, either by calculation or by comparison with other similar installations, that torsional vibration stresses which may occur in service are not excessive, and should be able to show to the satisfaction of the Surveyor that the intermediate shaft diameter obtained from the formula is adequate.



328. *Shafting of Steam Reciprocating Engines*

(a) Intermediate shafts of reciprocating steam engine installations should have diameters not less than are given by the following formula:

$$d = \sqrt[3]{\frac{D^2 \times S \times P}{f(r + 2)}}$$

- Where  $d$  = diameter of the intermediate shaft in inches,  
 $D$  = diameter of the low-pressure cylinder in inches, or the equivalent diameter where two or more low-pressure cylinders are used,  
 $S$  = stroke of the piston in inches  
 $P$  = working pressure at the boiler outlet in lb. per square inch,  
 $r$  = ratio of the swept volume of the low-pressure cylinder or cylinders to that of the high-pressure cylinder or cylinders,  
 $f$  = a coefficient from the following table, which has two values for each type of engine depending upon the nature of the service.

Type of compound, triple or quadruple expansion reciprocating engine	Service of Ship	
	Class I, II, IIA	Class III, IV, V
2 cranks at 90°	1900	2100
2 cranks at 180°	1350	1500
3 cranks at 120°	2150	2400
4 cranks balanced	2150	2400
4 cranks at 90°	2100	2300

Where the builders can show either by calculation or by comparison with previous similar installations that no serious torsional vibration stresses are likely to occur in service, the diameter of the intermediate shaft obtained from the formula may be reduced from  $d$  to  $d_1$  where  $d_1 = 0.95d$ . This reduction applies only to intermediate shafts.

(b) Crank shafts of screw reciprocating engines should not be less than  $d_c$  in diameter:

Where  $d_c = 1.05 \times d$

(c) Crank and paddle shafts of reciprocating engines of paddle steamers should not be less than  $0.94 \times d$  in diameter.

(d) Crank webs of built shafts should in general have dimensions not less than those obtained from the following formulae:

$$h = 0.625 \times d_c$$
$$t = 0.438 \times d_c$$

- Where  $d_c$  = required diameter of the crank shaft in inches,  
 $h$  = thickness of the web measured parallel to the axis of the shaft in inches,  
 $t$  = thickness of metal around the crank pin and journal holes measured radially in inches.

Crank webs of proportions other than those given above may be accepted provided that they are of equivalent strength.

Crank webs should be securely shrunk on the journals and crank pins. Where dowels are not fitted the shrinkage allowance should be about  $\frac{1}{8}$  of the diameter of the shaft except where the journals or pins are hollow when the allowance may be suitably increased.

Easily accessible reference marks should be provided on the outer ends of the journals and crank pins and on the adjoining webs.

### 329. *Shafting of Steam Reciprocating Engines combined with Exhaust Steam Turbines*

Intermediate shafts for installations where steam reciprocating engines are combined with exhaust steam turbines by means of gearing or otherwise, should have diameters of the intermediate shafting not less than those given by the following formula:

$$d = \sqrt[3]{\frac{(0.9 \text{ HP}_2 + 0.95 \text{ HP}_1) \times F}{R}}$$

- Where
- $d$  = diameter of the intermediate shaft in inches,
  - $\text{HP}_2$  = maximum indicated horse power of the reciprocating engine when working with the turbine,
  - $\text{HP}_1$  = shaft horse power of the turbine,
  - $F$  = 55 for passenger ships of Classes I, II and IIA,  
= 50 for passenger ships of Classes III, IV and V,
  - $R$  = revolutions per minute of the main propelling shafting,

The diameter of the intermediate shafting should in no case be less than  $d$  or  $d_1$  as obtained from the appropriate formula in paragraph 328 for the reciprocating engine when working without a turbine.

### 330. *Shafting of Heavy Oil Engines*

(a) Crank shafts of heavy oil engines should have diameters not less than those given by the following formula:

$$d_c = \sqrt[3]{\frac{D^2 \times (PL + CpS)}{10,000}}$$

- Where
- $d_c$  = diameter of crank shaft,
  - $D$  = diameter of cylinder,
  - $S$  = length of stroke,
  - $L$  = span of bearings adjacent to a crank measured from inner edge to inner edge,
  - $P$  = maximum pressure in lb. per square inch,
  - $p$  = mean indicated pressure in lb. per square inch,
  - $C$  = coefficient found from Table No. I.
- } in inches or millimetres.

TABLE NO. 1  
CRANK SHAFTS OF HEAVY OIL ENGINES  
Maximum Pressure 500 lb. per square inch and above

Number of Cylinders	Single Acting		Double Acting	
	4 Stroke	2 Stroke	2 Stroke	
	C.	C.	Arrangement of Cranks	C.
1	7.3	7.3		
2	7.3	7.3		
3	7.3	7.7	3 at 120°	7.2
4	7.3	8.6	4 at 90°	13.4
			4 at 45° and multiples of 45°*	8.7
5	7.7	9.3	5 at 72°	11.3
6	7.7	9.6	6 at 60°	13.1
			6 at 30° and multiples of 30°*	12.0
			6 at 120°†	16.6
7	8.6	9.8	7 at equal angles	13.8
8	8.6	10.0	8 at 45°	15.4
			8 at 90°‡	29.3
9	9.3	11.2	9 at 40°	16.8
10	9.3	12.3	10 at 36°	19.4
			10 at 72°†	25.0
11	9.6	12.7	11 at equal angles	22.0
12	9.6	13.5	12 at 30°	23.0
			12 at 60°‡	28.9

\* With single impulses at equal crank angles. † With two firing together. ‡ With four firing together.

(b) Crank webs of solid forged shafts should in general have dimensions not less than those given by the following formulae:

$$b = 1.33 \times d_c$$

$$h = 0.56 \times d_c$$

Crank webs of built shafts should in general have dimensions not less than those given by the following formulae:

$$h = 0.625 \times d_c$$

$$t = 0.438 \times d_c$$

Where  $d_c$  = required diameter of crank shaft,

$b$  = breadth of web for solid forged shaft,

$h$  = thickness of the web measured parallel to the axis of the shaft,

$t$  = thickness of the metal around the crankpin and journal holes measured radially.

} in inches or millimetres.



Crank webs of proportions other than those given above may be accepted providing they are of equivalent strength.

Crank webs should be securely shrunk on the journals and crank pins. Where dowels are not fitted the shrinkage allowance should be about  $\frac{1}{32}$  of the diameter of the shaft except where the journals or pins are hollow, when the allowance may be suitably increased.

Easily accessible reference marks should be provided on the outer ends of the journals and crank pins and on the adjoining webs.

(c) Intermediate shafts of heavy oil engine installations should have diameters not less than those given by the following formula:

$$d = C \times \sqrt[3]{\frac{\text{B.H.P.}}{R}}$$

Where  $d$  = diameter of intermediate shaft in inches,

B.H.P. = maximum designed brake horse power,

$R$  = revolutions per minute at maximum designed brake horse power,

$C$  = coefficient found from tables 2, 3 and 4.

The tables give various values for  $C$  according to the piston speed and the effect of the flywheel and rotating balance weights where fitted. This effect  $A$  is assessed by the following formula:

$$A = \frac{D^2 \times S}{(Wd^2 + 6.24 wr^2) \times R^2}$$

Where  $D$  = diameter of cylinder in inches,

$S$  = length of stroke in inches,

$R$  = revolutions per minute at maximum power,

$W$  = weight of flywheel in tons,

$d$  = diameter of flywheel in feet,

$w$  = total weight of balance weights in tons,

$r$  = radius of gyration of balance weights in feet.

Where the piston speed, or the value found for  $A$ , falls between those in the tables the coefficient  $C$  should be found by interpolating.

Flywheel shafts should have diameters not less than those required for the crank shafts.

(d) In adopting the diameter given by the formula in sub-paragraph (c) builders should be satisfied from their examination of the shafting system either by calculation or by comparison with other similar installations that torsional vibration stresses which may occur in service are not excessive and should be able to show to the satisfaction of the Surveyor that the intermediate shaft diameter is adequate. It may be necessary to avoid running continuously at certain critical revolutions.

TABLE 2  
INTERMEDIATE SHAFTS FOR 4 STROKE  
SINGLE ACTING HEAVY OIL ENGINES  
*Maximum Pressure 500 lb. per square inch and above*

Number of Cylinders	Value of A	Value of C for following piston speeds in feet per minute			
		700 and below	850	1000	1200 and above
1, 2, 3 or 4	001	4.03	4.03	4.03	4.03
	005	4.90	4.70	4.54	4.41
	010	5.43	5.07	4.80	4.57
5	001	3.96	3.96	3.96	3.96
	005	4.53	4.38	4.26	4.16
	010	4.85	4.59	4.38	4.26
6	001	3.90	3.90	3.90	3.90
	005	4.29	4.18	4.09	4.03
	010	4.51	4.30	4.18	4.07
	015	4.64	4.37	4.18	4.07
	No Flywheel or Balance Weights }	5.00	4.54	4.29	4.13
7	001	3.88	3.88	3.88	3.88
	005	4.14	4.09	3.99	3.99
	010	4.30	4.14	4.07	3.99
	015	4.40	4.18	4.07	3.99
	No Flywheel or Balance Weights }	4.63	4.29	4.12	4.03
8	001	3.85	3.85	3.85	3.85
	005	4.06	4.00	3.95	3.92
	010	4.15	4.04	3.98	3.92
	015	4.21	4.04	3.98	3.92
	No Flywheel or Balance Weights }	4.35	4.12	4.02	3.96
9	001	3.84	3.84	3.84	3.84
	005 to 015	4.04	3.96	3.92	3.90
	No Flywheel or Balance Weights }	4.15	4.02	3.96	3.91
10	001	3.82	3.82	3.82	3.82
	005 to 015	3.92	3.89	3.86	3.86
	No Flywheel or Balance Weights }	4.01	3.93	3.90	3.86
11 and 12	All values includ- ing no Flywheel or Balance Weights	3.80	3.80	3.80	3.80

**TABLE 3. INTERMEDIATE SHAFTS FOR 2 STROKE  
DOUBLE ACTING HEAVY OIL ENGINES**  
*Maximum Pressure 500 lb. per square inch and above*

Number of Cylinders	Arrangement of Cranks	Values of A	Value of C for following piston speeds in feet per minute			
			700 and below	850	1000	1200 and above
3	3, at 120°	.001	3.86	3.86	3.86	3.86
		.005	4.09	4.04	3.99	3.99
		.010	4.28	4.15	4.07	4.01
		.015	4.39	4.25	4.10	4.04
		No Flywheel or Balance Weights }	4.89	4.47	4.25	4.09
4	4, at 90°	.001	3.91	3.91	3.91	3.91
		.005	4.30	4.19	4.09	4.04
		.010	4.54	4.33	4.18	4.09
		.015	4.66	4.40	4.25	4.09
		No Flywheel or Balance Weights }	5.08	4.60	4.32	4.16
4	4, at 45° and multiples of 45°*	.001	3.85	3.85	3.85	3.85
		.005	3.94	3.91	3.88	3.88
		.010	4.01	3.95	3.91	3.88
		.015	4.05	3.97	3.91	3.88
		No Flywheel or Balance Weights }	4.15	4.01	3.95	3.91
5	5, at 72°	.001	3.82	3.82	3.82	3.82
		.005 to .015	3.90	3.82	3.82	3.82
		No Flywheel or Balance Weights }	3.95	3.90	3.86	3.86
6	6, at 60°	.001	3.80	3.80	3.80	3.80
		.005 to .015	3.91	3.88	3.84	3.84
		No Flywheel or Balance Weights }	3.95	3.91	3.88	3.84
6	6, at 30° and multiples of 30°*	.001	3.80	3.80	3.80	3.80
		.005 to .015	3.88	3.84	3.84	3.84
		No Flywheel or Balance Weights }	3.91	3.87	3.84	3.84
6	6, at 120°†	.001	3.90	3.90	3.90	3.90
		.005	4.23	4.09	4.03	3.99
		.010	4.37	4.18	4.07	3.99
		.015	4.45	4.24	4.09	4.01
		No Flywheel or Balance Weights }	4.66	4.31	4.13	4.04
7, 9, 9, 10, 11 and 12	At equal angles	All values including no Flywheel or Balance Weights	3.80	3.80	3.80	3.80
8	8, at 90°‡	.001	4.01	4.01	3.97	3.95
		.005	4.41	4.24	4.09	4.02
		.010	4.56	4.29	4.13	4.05
		.015	4.62	4.32	4.15	4.05
		No Flywheel or Balance Weights }	4.78	4.39	4.18	4.07
10	10, at 72°†	.001	3.80	3.80	3.80	3.80
		.005 to .015	3.94	3.90	3.86	3.86
		No Flywheel or Balance Weights }	3.98	3.91	3.88	3.86
12	12, at 60°‡	.001	3.80	3.80	3.80	3.80
		.005 to .015 and No Flywheel or Balance Weights }	3.89	3.86	3.84	3.84

\* With single impulses at equal crank angles. † With two firing together. ‡ With four firing together.



**TABLE 4**  
**INTERMEDIATE SHAFTS FOR 2 STROKE**  
**SINGLE ACTING HEAVY OIL ENGINES**  
*Maximum Pressure 500 lb. per square inch and above*

Number of Cylinders	Value of A	Value of C for following piston speeds in feet per minute			
		700 and below	850	1000	1200 and above
1 or 2	·001	4·05	4·05	4·05	4·05
	·005	5·13	5·00	4·85	4·71
3	·001	3·90	3·90	3·90	3·90
	·005	4·47	4·32	4·27	4·18
	·010	4·88	4·64	4·46	4·31
4	·001	3·87	3·87	3·87	3·87
	·005	4·16	4·09	4·04	4·00
	·010	4·38	4·25	4·11	4·05
	·015	4·51	4·29	4·16	4·05
5	·001	3·84	3·84	3·84	3·84
	·005	3·97	3·94	3·90	3·90
	·010	4·07	4·00	3·93	3·90
	·015	4·11	4·03	3·93	3·90
	No Flywheel or Balance Weights }	4·25	4·10	4·00	3·92
6	·001	3·82	3·82	3·82	3·82
	·005 to ·015	3·86	3·86	3·86	3·86
	No Flywheel or Balance Weights }	3·94	3·86	3·86	3·86
7, 8, 9, 10, 11 and 12	All values includ- ing no Flywheel or Balance Weights	3·80	3·80	3·80	3·80

### 331. Thrust Shafts

Thrust shafts transmitting torque should not be less in diameter at the collars than  $C \times d$ .

Where  $d$  = diameter 'd' as obtained for the intermediate shaft from the appropriate formula,

$C = 1·1$  where the shafting is driven by steam turbines or electric propulsion motor, or by heavy oil engines,

$= 1·05$  where the shafting is driven by steam reciprocating engines,

$= 1·1$  where the shafting is driven by steam reciprocating engines combined with exhaust turbines and where 'd' above has been determined by the formula in paragraph 329 or by 'd<sub>1</sub>' of paragraph 328(a) (see last sub-paragraph of 329) and  $= 1·05$  where 'd' above has been determined by 'd' (not d<sub>1</sub>) of paragraph 328(a).

Thrust shafts may be tapered down outside the collars to the diameter required for the intermediate shaft.

### 332. Tube Shafts

Shafts passing through stern tubes and not carrying the weight of the propellers should not be less in diameter than  $C \times d$ .

Where  $d$  = diameter 'd' as obtained for the intermediate shaft from the appropriate formula,

$C = 1.1$  where the shafting is driven by steam turbines, electric motors or heavy oil engines,

$= 1.05$  where the shafting is driven by steam reciprocating engines,

$= 1.1$  where the shafting is driven by steam reciprocating engines combined with exhaust turbines and where 'd' above has been determined by the formula in paragraph 329 or by 'd<sub>1</sub>' in paragraph 328(a) (see last sub-paragraph of 329) and  $= 1.05$  where 'd' above has been determined by 'd' (not d<sub>1</sub>) of paragraph 328(a).

Where any part of the tube shaft within the tube is exposed to sea water the value of  $C$  should be increased 2.5 per cent.

### 333. Propeller Shafts

(a) Propeller shafts should be not less in diameter than is given by the following formula:

$$d_p = (C \times d) + \frac{P}{K}$$

Where  $d_p$  = diameter of the propeller shaft in inches,

$d$  = diameter 'd' obtained for the intermediate shaft from the appropriate formula,

$C = 1.05$  for shafts driven by steam turbines, electric motors or heavy oil engines,

$= 1.0$  for shafts driven by steam reciprocating engines,

$= 1.05$  where the shafting is driven by steam reciprocating engines combined with exhaust turbines and where 'd' above has been determined by the formula in paragraph 329 or by 'd<sub>1</sub>' of paragraph 328(a) (see last sub-paragraph of 329) and  $= 1.0$  where 'd' above has been determined by 'd' (not d<sub>1</sub>) of paragraph 328(a),

$P$  = diameter of the propeller in inches,

$K = 144$  where a continuous liner is fitted,

$= 100$  where a continuous liner is not fitted.

Propeller shafts which run in stern tubes may have the end forward of the stern gland tapered down to a diameter at the coupling flange equal to 1.05 times the required diameter of the intermediate shaft.

(b) Continuous liners should preferably be cast in one piece, but if it is proposed to fit a liner in more than one piece the method of joining the pieces should be submitted for consideration.

The thickness of liners fitted on propeller shafts or tube shafts in way of the bushes should not be less when new than is given by the following formula:

$$T = \frac{d_p + 9}{32}$$

Where  $T$  = thickness of the liner in inches,

$d_p$  = diameter required for the propeller or tube shaft within the liner in inches.

The thickness of a continuous liner at the part between the bushes should not be less than  $0.75 \times T$ . Liners should be shrunk on or forced on to the shafts by hydraulic pressure. Securing pins should not be fitted.

(c) Effective means should be provided to exclude water from the part of the shaft between the after end of the liner and the propeller boss. Any cavity between the liner and the shaft clear of the close fitting portions should be filled with a suitable composition.

(d) The length of the bearing in the stern bush next to the propeller should not be less than four times the diameter required by the relevant formula for the shaft within the liner.

### 334. Coupling Flanges and Bolts

(a) The thickness of the coupling flanges at the pitch circle of the bolt holes should not be less than the required diameter of the coupling bolts at the face of the coupling. The thickness of the propeller shaft coupling should not be less than 0.25 times the diameter 'd' obtained for the intermediate shaft from the appropriate formula.

The radius of curvature at the fillet where the flange starts from the shaft should be not less than 0.125 of the diameter of the shaft adjacent to the flange.

When couplings are separate from the shafts provision should be made to resist the astern pull.

(b) The coupling bolts should not be less in diameter, at the coupling faces, than that given by the following formula:

$$\text{Diameter of coupling bolts} = \sqrt{\frac{d^3}{3.5 \times n \times r_b}}$$

Where d = diameter (d not  $d_1$ ) obtained for the intermediate shaft from the appropriate formula. Except that for crank shaft and flywheel shaft couplings of heavy oil engines d is to be taken as 0.95 times the diameter required for the crank shaft,

n = number of bolts in the coupling,

$r_b$  = radius of the pitch circle of the bolts in inches.

## Chapter 10

### MACHINERY

#### 335. General

The propelling machinery of every passenger ship should have sufficient power for going astern to ensure proper control of the ship in all circumstances. The astern power should generally be not less than 60 per cent. of the ahead power.

The machinery arrangements should be such that the propulsion of the ship can be reversed with sufficient speed to enable the ship to be properly handled.

#### 336. Steam Turbines

(a) Means should be provided which will shut off automatically the steam from any ahead turbine, and any other machinery served by the same lubricating oil system as the turbine, in the event of any failure of that system. This automatic arrangement need not shut off steam to the astern turbine, which may be required to stop the machinery quickly.

(b) An emergency overspeed governor should be provided for the ahead turbine or set of turbines driving each propeller shaft either direct or through gearing so as to shut off the steam automatically in the event of overspeed. Hand-trip gear should also be provided for shutting off the steam.

Overspeed governors should in general be fitted to steam turbines driving main or auxiliary generators or other auxiliaries.



(c) The nozzle boxes of impulse steam turbines should be tested by hydraulic pressure to one and one-half times the maximum pressure to which they may be subjected in service. This maximum pressure will generally be the pressure at which the superheater safety valve is set to operate.

The steam casing of all turbines should be tested by hydraulic pressure to one and one-half times the maximum working pressure in such casings or to 30 lb. per square inch, whichever is the greater.

### 337. Steam Reciprocating Engines

(a) The cylinders of steam reciprocating machinery should be tested by hydraulic pressure as follows:

<i>Type of Engine</i>	<i>Cylinder Pressure</i>	<i>Pressure of Test</i>
Compound Expansion	High	$1\frac{1}{2} \times \text{M.W.P.}$
	Low	30 lb. per sq. inch
Triple Expansion	High	$1\frac{1}{2} \times \text{M.W.P.}$
" "	Intermediate	$\frac{1}{2} \times \text{M.W.P.}$
" "	Low	30 lb. per sq. inch
Quadruple Expansion	High	$1\frac{1}{2} \times \text{M.W.P.}$
" "	1st Intermediate	$\frac{3}{4} \times \text{M.W.P.}$
" "	2nd Intermediate	$\frac{1}{2} \times \text{M.W.P.}$
" "	Low	30 lb. per sq. inch.

Where M.W.P. = Maximum working pressure of the boiler to which the machinery is connected.

(b) The crank cases of steam reciprocating engines having forced lubrication should be fitted in accordance with the relevant requirements of paragraph 345.

### 338. Oil Engines used for Propulsion

(a) Fuel oil supplied for use in these engines should have a flash point not less than 150°F.

(b) The cylinder liners should be tested by hydraulic pressure to at least 100 lb. per square inch, and the cooling passages of the cylinders, covers and other fluid cooled parts should be tested by hydraulic pressure to at least 30 lb. per square inch.

(c) Engines of less than 150 B.H.P. may be surveyed and tested in accordance with paragraph 340(c).

(d) With direct reversing engines the reversing gear should be such that, when operated quickly from ahead to astern or vice versa, there should be no possibility of the propelling machinery continuing to run in a direction contrary to that corresponding to the position of the reversing gear.

(e) Propelling engines should in general be fitted with an efficient governor to prevent excessive racing.

(f) Each engine cylinder over 8" in diameter should be fitted with an efficient relief valve, the discharge from which should be so directed as not to be harmful to those in attendance. In the case of engines where the cylinders do not exceed 8" in diameter relief valves need not be fitted.

The relief valves should in general be set to not more than 20% in excess of the maximum designed cylinder pressure.

### 339. Compressed Air Starting Arrangements

(a) Ships of Classes I, II and II(A) propelled by oil engines which require compressed air for starting should be provided with:

- (i) at least two starting air compressors, each of which should be of efficient design and of sufficient capacity for the intended service and,

- (ii) in addition to the above two air compressors, a starting air compressor which can be put into operation without external aid, when no power units are running and when no compressed air is available in the ship. The additional air compressor will not however be required if one of the two compressors referred to can be put into operation under these conditions.
- (iii) at least two starting air receivers the aggregate capacity of which should be sufficient to start each main engine at least twelve times where the engines are reversible or six times where they are non-reversible.

The arrangements should be such that one of the receivers can be kept fully charged, ready for use, in case the air pressure in the other receiver or receivers falls below the pressure necessary to start the main engine. The number of starts from one air receiver and the lowest pressure at which the engines can be satisfactorily started should be ascertained at the trials and reported to headquarters.

(b) Ships of Classes III to VI(A) inclusive, propelled by oil engines which require compressed air for starting should be provided with:

- (i) at least one starting air compressor which should be of efficient design and of sufficient capacity for the intended service, and,
- (ii) in addition to the above air compressor, a starting air compressor which can be put into operation without external aid, when no power units are running and when no compressed air is available in the ship.

The additional air compressor will not however be required if the compressor referred to in (i) above can be put into operation under these conditions.

- (iii) at least one starting air receiver, the total capacity of which should be sufficient to start each main engine at least twelve times where the engines are reversible, or six times where they are non-reversible.

The number of starts from one air receiver and the lowest pressure at which the engines can be satisfactorily started should be ascertained at the trials and reported to headquarters.

#### **340. *Oil Engines Driving Electric Generators and Auxiliaries***

(a) Fuel oil supplied for use in these engines should have a flash point not less than 150°F., except as allowed for emergency generator engines by Rules 36(2) and 37(2).

(b) The designs of the engines should be submitted to the Engineer Surveyor-in-Chief unless of accepted standard design. These should include lubricating arrangements and, in the case of engines driving emergency generating sets, the position and general arrangement of the sets.

(c) Engines of less than 150 B.H.P. normal rating need not be surveyed during construction except as provided for in Appendix V but the makers should give guarantees covering the physical properties of the material of the crankshafts and gear shafts and the hydraulic tests of water spaces. Surveyors are to visit the works of makers of these engines occasionally to satisfy themselves regarding the standard of production and testing and they may require Brinell or other check tests of the shafts at any time.

In all cases running trials after installation on board should be witnessed under service conditions.

(d) It is essential that emergency generating sets should be capable of being started readily when cold. If hand starting is demonstrated to be practicable under conditions likely to arise in service, alternative means of starting need

not be required. Where hand starting is not practicable, other means should be provided. This means of starting should in general provide for not less than 12 starts in a period of 30 minutes without recourse to sources of power within the machinery space. Where air starting only is used an independent recharging device should be provided adjacent to the emergency generator and the capacity of the air bottle or bottles together with the independent recharging device should be such as to provide for the above number of starts in the time stated. The recharging device may be a manually operated compressor or a hand starting diesel driven compressor. Consideration will be given to special starting devices. Starting by means of electric batteries may be accepted provided there is an alternative means of starting, which may be compressed air.

In all cases the Surveyor should witness starting and running trials of the emergency generating set after installation on board.

(e) Generating sets should, if practicable, be placed with their axis of rotation in a fore and aft direction. The lubrication should be efficient at all running speeds, with the ship listed to any angle up to 15 degrees and with a fore and aft trim of 10 degrees and when rolling up to  $22\frac{1}{2}$  degrees from the vertical, without the spilling of oil, except that the lubrication of emergency generators should be efficient and continuous with the ship listed to any angle up to  $22\frac{1}{2}$  degrees and with a fore and aft trim of 10 degrees.

### **341. Air Compressors**

(a) An efficient relief valve should be fitted in the high pressure discharge from each air compressor. The relief valve should be of such a size and so set that the maximum accumulation pressure will not exceed the working pressure by 10 per cent. should the compressor discharge valve be closed when the compressor is running normally.

(b) An efficient relief valve or safety diaphragm should be fitted on the casing of the high pressure air cooler to provide ample relief in the event of a high pressure air tube bursting.

(c) Means for draining off water and oil should be fitted in the interstage and final discharge pipes of air compressors.

(d) Cylinders of air compressors should be tested by hydraulic pressure to twice their maximum working pressure.

(e) Cooling coils or tubular coolers of each stage should be tested by hydraulic pressure to twice the maximum working pressure of that stage.

(f) The cooling passages of air compressors and the cooler casings should be tested by hydraulic pressure to 30 lb. per square inch.

### **342. Air Receivers**

(a) All steel used in the construction of air receivers should be tested. It must comply with the requirements of paragraphs 172 to 186.

(b) Air receivers should be provided with means of access for the purpose of inspection and cleaning.

(c) Air receivers should be provided with efficient drains, and be protected by relief valves of satisfactory design, suitably loaded and positioned to avoid any possibility of overpressure. Any air receiver which can be isolated from a relief valve should be fitted with a fusible plug or plugs to discharge the contents in case of fire. Surveyors should see that the relief valves are set to the correct pressure and are of sufficient size having regard to possible accumulation of pressure.

(d) Riveted air receivers should comply with the requirements for cylindrical boilers as regards the cylindrical portion of the shell. Unstayed end plates of



riveted receivers dished to partially spherical form should comply with the requirements for fusion welded pressure vessels (paragraph 294 or 295).

(e) Fusion welded air receivers should comply with the requirements for fusion welded pressure vessels.

(f) All air receivers should be tested by hydraulic pressure as follows:

Construction of Receiver	Maximum working pressure lb. per sq. inch	Test pressure lb. per sq. inch
Riveted	Not over 100	$2 \times \text{M.W.P.}$
Riveted	Over 100 but not over 300	$1\frac{1}{2} \times \text{M.W.P.} + 50$
Riveted	Over 300	$\text{M.W.P.} + 200$
Fusion Welded	Not over 100	$2 \times \text{M.W.P.}$
Fusion Welded	Over 100	$1\frac{1}{2} \times \text{M.W.P.} + 50$

Where M.W.P. = Maximum working pressure.

(g) On completion, each air receiver is to be stamped over the access opening as follows:

M.T.  
TESTED .....LB  
W.P. ....LB.  
DATE  
SURVEYOR'S INITIALS

343. Air Bottles

(a) Air bottles should be of seamless steel and they may be made from seamless tube with the ends of the bottle worked down from the tube, or of equally efficient construction.

When made from tubes, the tubes should be gauged before working down the ends and should be of uniform thickness.

(b) The material should be tested and comply with the requirements of paragraph 209.

(c) After manufacture air bottles should be carefully annealed and then tested by hydraulic pressure to twice the maximum working pressure.

(d) A maximum working pressure not exceeding that obtained from the following formula may be allowed:

$$\text{W.P.} = \frac{35 \times S \times (t - 2)}{D}$$

Where W.P. = working pressure in lb. per square inch,  
S = transverse tensile strength of tube in tons per square inch,  
D = internal diameter of the bottle in inches,  
t = thickness in 32nds of an inch.

(e) Air bottles should be fitted with efficient drains and be protected by efficient relief valves and fusible plugs in accordance with the requirements of paragraph 342(c).

(f) Means for internal inspection and cleaning should be provided.

(g) On completion, each air bottle is to be stamped near the neck or opening as follows:

M.  T.  
TESTED .....LB.  
W.P. ....LB.  
DATE  
SURVEYOR'S INITIALS

#### **344. Air Pressure Pipes and Fittings**

(a) Air pressure pipes should comply with the requirements of paragraphs 206 to 208 and 313 to 316 as applicable.

Air pressure pipes should be properly supported and provision should be made to keep the interior of the pipes free from oil and either to prevent the passage of flame from the cylinders of the engine to the pipes or to protect the pipes from the effects of an internal explosion.

(b) Air pressure pipes and fittings should be tested by hydraulic pressure to twice the maximum working pressure.

#### **345. Crankcase Safety Arrangements**

(a) In the construction of, and fittings for, the crankcases of forced lubrication engines in which oil spray and mist is normally present, means should be adopted to prevent danger from the result of explosion (Rule 65).

(b) The crankcases and inspection doors should be of robust construction and the attachment of the doors to the crankcase or entablature substantial.

(c) There should be fitted to the crankcase of each cylinder and to any associated gear case one or more non-return valves designed to relieve any abnormal pressure. These valves should be so placed or their outlets so guarded that any flame discharged by an explosion will be so directed that those on duty in the vicinity will not be endangered. Engines having cylinders of not more than 12" bore, and having strong crankcases and doors, may have a relief valve or valves at the ends only, and those having cylinders of not more than 6" bore similarly constructed, need not be fitted with relief valves.

The total clear area through the relief valves should not, in general, be less than 0.5 square inch per cubic foot of gross crankcase volume.

(d) Lubricating oil drain pipes from engine sump to drain tank should extend to well below the working level of oil in the tank.

In multiple engine installations drain pipes or vent pipes are to be arranged so that the flame of an explosion cannot pass from one engine to another.

(e) In large engines having more than six cylinders it is recommended that a diaphragm be fitted at about mid length to prevent the passage of flame.

Consideration should be given to the fitting of means for the detection of overheating and for the injection of inert gas.

#### **346. Cooling Water Systems**

(a) Cooling water systems generally should comply with the following:

(i) Each system, including the connected water passages, should be arranged so as to avoid air pockets as far as possible. Air cocks should be provided where necessary.

(ii) Suitably placed doors should be provided in the water spaces for cleaning and inspection.

(iii) Suitable means should be provided for ascertaining that the system is in order and that sufficient water is passing through each part which requires to be cooled.

(iv) Means should be provided for preventing overpressure in any part of the system.

(b) Ships propelled by steam driven machinery or having steam driven auxiliaries for the maintenance of services essential for the safety of the ship or persons on board should have, in addition to the normal supply of circulating water to the machinery, arrangements for an adequate alternative supply.

(c) Ships propelled by internal combustion machinery or having internal combustion auxiliary engines for the maintenance of services essential for the safety of the ship or persons on board should comply with the following:

- (i) At least two cooling water pumps should be fitted, each of which should be capable of providing an adequate supply of sea water to the machinery, auxiliary engines and any oil coolers and fresh water coolers connected thereto, except that in ships of Classes III to VI(A), inclusive, only one cooling water pump need be provided.
- (ii) In ships of Classes I, II and II(A), where a fresh water cooling system is fitted, the fresh water pumping arrangements should be such that an adequate supply of fresh water will be provided and that an adequate alternative supply of cooling water will be available from a stand-by fresh water pump or from an emergency connection to a sea water pump.
- (iii) Where direct sea water cooling is employed, suitable suction strainers should be fitted. The strainers should be capable of being cleaned from within the ship without interruption of the water supply.
- (iv) Exhaust manifolds, pipes and silencers should be efficiently cooled or lagged, except where it may be unnecessary, as in funnel casings.

### **347. Lubricating Oil Systems**

(a) Where the propelling machinery is lubricated or cooled by oil under pressure, at least two lubricating oil pumps should be provided each of which should be adequate for circulating such oil, except that in ships of Classes III to VI(A), inclusive, only one lubricating oil pump need be provided.

(b) Suitable lubricating oil strainers should be provided and, except in ships of Classes III to VI(A) inclusive, the strainers should be capable of being cleaned without interrupting the supply of oil.

(c) Means should be provided for ascertaining whether the lubricating system is working properly and in every case a pressure gauge should be fitted in the system to indicate the pressure on the delivery side of the pumps.

(d) Means should be provided for preventing overpressure in any part of the system. Relief valves, where fitted, should be in closed circuit.

(e) An audible alarm should be fitted to the lubricating oil system of ships of Classes I, II and II(A) which will give warning should the pressure of the oil supply to the engines fall below that required to maintain an adequate supply.

(f) Oil level indicators fitted to lubricating oil storage or service tanks should preferably be of a type that does not require the piercing of the lower part of the tank so that in the event of damage there will be no spillage and in the event of fire the contents of the tank will not add to the outbreak.

(g) In ships, other than ships of Classes III to VI(A) inclusive, propelled by turbine machinery or having turbo-electric propelling machinery, the lubricating oil arrangements should be such that an emergency supply of oil is available sufficient to maintain an adequate supply of lubricating oil for at least three minutes. This emergency supply should automatically come into use should the supply of lubricating oil from the pump or pumps fail. A system employing a gravity tank would be considered satisfactory for this purpose. The automatic arrangements for shutting off steam from the ahead turbine if the lubricating oil supply fails are dealt with in paragraph 336(a).



### **348. *Ventilation of Machinery Spaces, etc.***

Machinery and boiler spaces should be provided with adequate means of ventilation for all normal conditions of service (see also paragraph 368(a)).

### **349. *Auxiliary Boilers***

Where auxiliary boilers are fitted in ships propelled by oil engines it is strongly recommended that they should be in a compartment or space separate from the engine space.

### **350. *Machinery Arrangements on vessels of Classes V, VI, and VIA***

(1) Vessels of Class VI over 60 feet in length fitted with internal combustion machinery and going more than 5 miles from the starting point, should be fitted with twin screws. If for any special reasons application is made for a single screw Class VI vessel of the size indicated to ply beyond 5 miles from the starting point the case should be submitted to headquarters for consideration.

(2) Machinery including shafting shall be fenced where necessary in order to protect persons in the vessel from injury.

(3) Exhaust pipes should not generally be carried through enclosed passenger spaces. No unjacketed exhaust pipe will be permitted in any enclosed motor or other space.

If the temperature of the exhaust pipe exceeds 400°F. under full working conditions it must be water cooled.

## ***Chapter 11***

### **OIL FUEL INSTALLATIONS**

#### **351. *Risk of Fire***

The Rules concerning oil fuel installations in both oil fired steamships and motor ships, together with these Instructions, are aimed mainly at preventing the outbreak and spread of fire, but they will be of no effect if certain simple precautions are neglected. Fires generally originate from occurrences which might be regarded as insignificant; for instance from oil dripping from the furnace fronts on to the tank top or from the ignition of an almost imperceptible spray of oil leaking from a gland or joint.

Oil catches fire rapidly and the speed at which the fire spreads depends, to a great extent, on the temperature of the oil relative to its flash point. If the temperature of any waste oil in the bilges or on tank tops is near to the flash point the fire spreads very quickly and, if the temperature exceeds the flash point, there will be an added risk of explosion. Two precautions are, therefore, of the greatest importance. Firstly, the temperature of the surfaces on which waste oil may collect should be kept cool, so that their temperatures are at least 30°F. below the flash point of the oil. Secondly, the conditions which will allow a small fire to spread to an accumulation of waste oil in the bilges, on boiler flats or on double bottom tank tops must be avoided, and this can only be achieved by maintaining a high standard of cleanliness.

When visiting ships in which oil fuel is used Surveyors should be satisfied that these precautions are observed; where difficulty is experienced in obtaining observation of these precautions the Surveyor should send a report to headquarters.

The use of coal or oil alternately or together is to be discouraged, especially the use of coal and oil together. When this practice is proposed the case should be submitted to headquarters for special consideration.

### 352. *Submission of Plans and Particulars*

Detailed plans of oil fuel storage, settling, overflow and daily service tanks which are to be built into the ship's structure should be sent to the Chief Ship Surveyor whether the tanks are to be constructed to the requirements of a classification society or not. Detailed plans of tanks which are not to be built into the ship's structure are to be sent to the Engineer Surveyor-in-Chief.

The Engineer Surveyor-in-Chief will also require plans showing:

- (i) The positions of the storage, settling and service tanks.
- (ii) The filling and relief arrangements.
- (iii) The air, overflow, sounding and pumping systems, including the means of isolating oil fuel from water ballast and the remote control required for certain valves.
- (iv) Arrangement of gutterways, coamings, save-alls, and screens.
- (v) General arrangement of the oil fuel units and associated pipes and fittings, and the design of the filters and heaters in the units, unless they are of an accepted design.
- (vi) The arrangements as above in oil fired galleys.

### 353. *Surveys*

At initial surveys the Surveyor should see that the oil fuel installations are fitted in accordance with the accepted plans and should witness the hydraulic tests required by these Instructions. Remote controls and other safety devices should be tested and on completion of the installation Surveyors should witness operating trials.

At periodic surveys, Surveyors should see that machinery spaces are clean, particularly in way of boilers and oil fuel installations, that remote control gearing required by the Rules in respect of certain valves is in good working order and that the markings and notices at the operating positions are easily legible.

### 354. *Machinery Space Arrangements*

There must be no woodwork in the boiler room or compartment containing the settling tanks, oil fuel pump, or oil fuel unit, and no wood or other combustible matter should be allowed to accumulate therein or in the vicinity of the oil fuel storage tanks.

Plating of machinery compartments in which oil fuel is used should not be coated with cement having a bitumastic or similar base, unless it is clearly demonstrated that the cement is neither inflammable nor capable of evolving obnoxious fumes in the event of a fire in the compartment in which it is used.

Bilge suction pipes of lead are not permissible in boiler spaces or engine spaces where oil fuel tanks or oil fuel pumping units are situated. (See Rule 27(2)).

Boiler room casings should be efficiently insulated more particularly when there is any possibility of woodwork in the spaces adjacent to the casings being affected by a fire in the boiler rooms. The insulation should comply with Rule 44 and paragraph 151. (See also Rule 47).

The bottoms of oil fired boilers should be well insulated so that any oil which may have escaped on to the tank top will not be heated to a dangerous degree.

In order to facilitate inspection and cleaning of the tank top and bilges the engine room and boiler room platforms should be kept well clear of tank and bulkhead plating.

Where the access provided from the engine room to the boiler room would be likely to be rendered inaccessible in the event of a fire it is recommended that emergency access should be provided.

### **355. Flash Point**

The flash-point of the oil fuel supplied for use in oil fired boilers or oil engines should not be less than 150°F. (closed test) as determined by recognised standard types of flash-point apparatus (except as provided for in Rules 36(2) and 37(2) and Appendix VI).

With each supply of oil taken on board a guarantee should be supplied by the vendor, and signed by a responsible official in his employ, of the actual closed test flash-point, the type of instrument by which the test was made being specified in every case. These particulars should be entered in the engine-room log book.

A standard type of apparatus for determining the closed flash-point up to temperatures of 200°F. should be provided to enable the chief engineer to make tests where necessary to ensure that the closed flash-point is not below 150°F.

### **356. Storage of Oil Fuel**

(a) Oil fuel may be carried in double bottom tanks under the machinery spaces and under holds and in peak tanks, deep tanks and other tanks of approved construction. Oil fuel tanks should not be situated directly above boilers or other heated surfaces, nor should they be abreast the boilers unless this is unavoidable. Oil tanks which do overhang the boilers should be fitted with shield plates to prevent leaking oil dripping on to the boilers.

(b) Double bottom compartments used for oil fuel storage are to be fitted with watertight centre divisions, except in the narrow tanks at the forward and after ends of the ship. In other storage tanks suitable wash plates are to be fitted when necessary.

(c) If fresh water is stored in a tank adjacent to an oil tank, a cofferdam is to be fitted to prevent the water being contaminated.

(d) In ships trading in climates where the cold may cause the oil to become viscous, heating coils should be fitted in the storage tanks, or other equally efficient means should be provided to ensure that the oil will flow freely through the pipes.

(e) All oil fuel tanks should be provided with save-alls, gutters or cofferdams as necessary to prevent the spread of any leaking oil. Gutters should drain to sumps or wells.

Where the oil tanks are adjacent to cargo holds, or where the double bottom tanks under the cargo holds are used for the storage of oil fuel, efficient means should be provided by wells or gutters to prevent leaking oil coming in contact with the cargo, and to ensure that such oil will drain freely into the limbers or wells.

Where tanks are of welded construction save-alls or gutters need not be provided except in positions where there are manhole doors, valves or other fittings, and in boiler rooms where tanks form part of the ship's structure.

### **357. Settling, Storage and Service Tanks**

(a) It is recommended that settling tanks should not be built into the ship's structure.

Settling and daily service tanks are to be constructed in accordance with the plans as accepted by the Engineer Surveyor-in-Chief or the Chief Ship Surveyor and are not to be situated directly above the boilers or other heated surfaces.

(b) A suitable thermometer pocket is to be fitted to each settling tank.

Open drains for removing the water from the oil in storage or settling tanks are not allowed unless the drain fitting is of the weighted lever or other self-closing type.



(c) To avoid leakage of oil from oil fuel tanks to the bilges through bilge pipes, these pipes are not to be led through oil fuel tanks unless the pipes are enclosed in an oil tight trunkway (see Rule 27(3)).

### **358. *Open Discharge of Hot Oil***

The temperature of oil in tanks or separators (including separators of the centrifugal type) which are fitted with open drains should not ordinarily exceed 125°F., and suitable notices to this effect should be displayed.

Where, however, oils of comparatively high viscosities and flash-points are provided no objection should be raised to the oil in the settling tanks or separators being heated to a temperature in excess of 125°F. if this is necessary for the proper working of the oil fuel plant, and if the margin between the temperature of the oil and its ascertained flash-point is never less than 35°F.

### **359. *Tests of Storage, Service, and Settling Tanks***

(a) Every service or storage tank is to be tested by filling it with water to a head at least one foot more than can possibly come upon the tank in service but to not less than 15 feet above the bottom of the tank in the case of tanks not forming part of the ship's structure. In new ships the double bottom is, however, to be tested with a head of water at least up to the margin line.

(b) Every settling tank is to be tested by hydraulic pressure to 15 lb. per square inch. When testing, the pressure gauge may be placed level with the bottom of the tank. If, however, in ordinary conditions of service the head pressure on the bottom of the tank exceeds 15 lb. per square inch, the test applied should be in accordance with sub-paragraph (a).

### **360. *Filling Arrangements***

(a) Oil fuel filling stations should be isolated from other spaces in the ship and should be efficiently drained and ventilated.

(b) Provision should be made which will prevent overpressure in any oil filling pipe lines such as may occur during filling operations, if one tank-filling valve is closed before another is opened.

(c) Any relief valve on the filling line should discharge into an overflow tank of suitable capacity fitted with an alarm device, alternatively the discharge from the relief valve may be led back to the fuelling barge or station.

### **361. *Air and Overflow Arrangements***

(a) Every oil fuel tank should be fitted with at least one air pipe the open end of which is to be led to the open air in such a position that no danger of fire or explosion will be incurred from the issuing oil vapour when the tank is being filled, and every such pipe should be fitted with a wire gauze diaphragm of ample area which can readily be removed for cleaning.

(b) Where any oil tank can be filled under pressure either from the ship's pumps or when bunkering, the aggregate area of the air pipe or pipes, or any overflow pipe or pipes connected to an overflow system, which are connected to the tank, should not be less than 1½ times the aggregate area of the filling pipes. (See also paragraph 104, Part II).

Generally the internal diameter of any air pipe should be not less than 2 inches.

(c) Where air pipes serve as overflow pipes there must be no possibility of the overflow running into or near a boiler room, galley or any other place in which it might be ignited.

(d) Rule 75(3) requires provision to be made to prevent the accidental discharge or overflow of oil overboard. For this purpose the system should provide

for the overflow from any oil fuel tank to be led to an overflow tank of suitable capacity fitted with an alarm device. It is desirable that a visual indicator be provided in the overflow pipe to indicate when the tanks or the filling line relief valve are overflowing.

(e) Where air or overflow pipes pass through the cargo holds, they should be suitably protected against damage.

### **362. *Sounding Arrangements***

(a) Efficient means are to be provided for ascertaining the oil level in every oil fuel tank, either by sounding pipes or by an accepted indicating apparatus. Sounding pipes should not terminate in a passenger or crew space nor in any space which is not efficiently ventilated. Where sounding pipes or connections to indicators pass through the cargo holds, they should be suitably protected against damage.

(b) Short sounding pipes to oil tanks situated in or below machinery spaces should, as far as possible, be avoided; if fitted, they should be provided with self-closing fittings. If the self-closing fittings are in the form of cocks they should have parallel plugs with handles permanently attached and so loaded that, on being released, they close the cocks automatically. If sounding pipes terminate in a boiler room or engine room they should be so arranged that oil will not be discharged on to any part of the boilers or their fittings, or on to any heated surfaces such as exhaust pipes of oil engines or on to electric generators or motors, if the selfclosing fittings at their upper ends are opened when filling or when oil is surging in the tanks, due to the motion of the ship.

(c) Sounding arrangements or oil level indicators on settling, daily service or other oil tanks must not allow oil to escape should the tanks be overfilled.

Oil level indicators should be of a type that does not require the piercing of the lower part of the tank so that in the event of damage there will be no spillage and in the event of fire the contents will not add to the outbreak.

### **363. *Pumping Arrangements***

Suitable provision should be made to isolate oil fuel from water ballast, and pumping arrangements should permit of oil fuel being transferred in the event of fire from any storage or settling tank to another part of the ship. Provision should be made to prevent any accidental discharge or overflow of oil overboard.

### **364. *Steam Heating Arrangements***

Where steam is used for heating oil, either in tanks, heaters or separators, the exhaust drains should discharge the water of condensation into an observation tank.

The steam heating pipes in contact with oil should be of steel; the thickness of the pipes should be not less than given by the appropriate formula in paragraph 313. The pipes are to be tested by hydraulic pressure, after being fitted on board, to twice the maximum working pressure.

### **365. *Oil Fuel Pumps, Heaters, Filters, etc.***

(a) The pumps for the oil fuel system should be entirely separate from the feed, bilge and ballast pumps and their connections, and should be provided with efficient relief valves which should be in closed circuit, e.g. discharging to the suction side of the pumps.

(b) Means should be provided for stopping every oil fuel pressure pump and transfer pump from a position outside the compartment in which the pump is situated. The control position should be such that it will not be likely to be rendered inaccessible by a fire in the engine or boiler rooms.

Cocks or valves should be interposed between the pumps and the suction pipes in order that the pipes may be shut off when the pumps are opened out for overhauling.

(c) In every ship there should be not less than two oil fuel units, each comprising a pressure pump, filters and a heater.

Heaters and pressure filters should be to accepted designs and are to be tested with their pipes and fittings, after jointing, to 400 lb. per square inch or to twice the maximum working pressure whichever is the greater (see paragraphs 290 and 325). Provision is to be made to prevent overpressure in any part. Any relief valves fitted to prevent overpressure in the oil fuel heater should be in closed circuit.

(d) Save-alls or gutters should be provided under oil fuel pumps, filters, heaters, etc., to catch leaking oil, or oil that may be spilled when any cover or door is removed, and they are to be provided beneath the furnace mouths of cylindrical boilers, and beneath the oil burners on water tube boilers, to catch any oil that may escape from the burners. Screens should, if necessary, be fitted in way of oil fuel pumps, filters and heaters to prevent the possibility of escaping oil coming into contact with boilers or other heated surfaces.

(e) Oil fuel separators should be to accepted designs and provision is to be made to prevent overpressure in any part and to ensure that any discharge of oil vapour is led to a safe place.

### 366. *Oil Pipes*

(a) The oil pressure pipes should be of steel of seamless or other accepted construction and those for conveying heated oil should be placed in a conspicuous position above the platforms in well lighted parts of the boiler room or engine room. Flexible pipes of suitable construction may be accepted between the burners and the supply line if made of fire and oil resisting material.

The thickness of the seamless steel pipes should be that given by the appropriate formula in paragraph 313 for a working pressure of 200 lb. per square inch or the pressure to which the relief valves on the system are loaded, whichever is the greater. The scantlings of the coupling flanges should be suitable for a corresponding pressure. The flanges should be machined and any jointing material used should be the thinnest possible and impervious to oil heated to 250°F.

The pipes and fittings are to be tested after jointing, to 400 lb. per square inch, or to twice the maximum working pressure, whichever is the greater. (See paragraphs 290 and 325).

(b) Other oil pipes should be made of steel and should be led sufficiently high above the inner bottom if any, to facilitate the inspection and repair of the pipes. The scantlings of the coupling flanges should be suitable for a working pressure of at least 100 lb. per square inch, the flanges should be machined and the jointing material used must be impervious to oil. After jointing, the pipes and fittings are to be tested to 50 lb. per square inch or to twice the maximum working pressure whichever is the greater.

### 367. *Valves and Fittings to Pipes*

(a) Every oil fuel suction pipe from any oil fuel tank situated above an inner bottom, and every oil fuel levelling pipe within the boiler room or engine room, should be fitted with a valve or cock secured to the tank to which the pipe is connected. Every such valve or cock fitted to an oil fuel suction pipe in the boiler room or engine room should be so arranged that it can be closed from the



compartment in which it is situated and from a readily accessible position outside the compartment which is not likely to be cut off or rendered inaccessible by a fire in the boiler or engine spaces. Every such valve or cock fitted to an oil fuel levelling pipe should be arranged so that it can be closed or opened from a readily accessible position above the bulkhead deck not likely to be cut off or rendered inaccessible by a fire in the compartment in which the pipe is situated.

If any tank filling pipe is not connected to an oil fuel tank at or near the top of the tank it should be fitted with a non-return valve or with a valve or cock secured to the tank to which it is connected and so arranged that it may be closed both from the compartment in which it is situated and from a readily accessible position outside the compartment which is not likely to be cut off or rendered inaccessible in the event of a fire in that compartment.

(b) Master valves at the furnace fronts controlling the supply of oil to sets of burners should be of the quick closing type, and fitted in a conspicuous and readily accessible position not likely to be cut off by fire. It is recommended that shut off valves should be arranged on oil pressure systems for shutting off any faulty section, without interfering with other sections. Valves which control the supply of heated oil to the system, or sections of the system, should be painted bright red for identification in an emergency.

Every valve used in connection with the oil fuel installation should be so designed and constructed as to prevent the cover of the valve chest being slackened back or loosened when the valve is operated.

(c) Provision should be made to prevent oil being turned on to any burner unless it has been correctly coupled up to the oil supply line and to prevent the burner being removed before the oil is shut off.

### **368. Ventilation**

(a) Ample ventilation should be provided in engine, boiler and pump rooms, where oil fuel is used and also in all compartments adjacent to any oil storage tanks or in which an oil storage tank is situated. This ventilation should supply fresh air to all parts of these spaces and should be capable of removing foul air in a reasonably short time.

(b) The clearance space between the boilers and tops of double bottoms, and between the boilers and the sides of the storage tanks or bunkers in which oil fuel is carried must be adequate for the free circulation of air necessary to keep the temperature of the stored oil well below the flash-point.

(c) Where water tube boilers are installed, it is recommended that there should be a space of at least two feet six inches between the tank top and the underside of the boiler casing.

### **369. Lighting**

In spaces where oil vapour may accumulate, no artificial light capable of igniting inflammable vapour should be allowed. Such spaces are to be lighted by electricity and no switches or fuses may be placed in them; the electric lamps are to be protected by air-tight glasses and by wire guards, if the latter are considered necessary. Portable lamps supplied with current through flexible cables are not permitted. Self-contained battery-fed lamps of a type which have been accepted for use in atmospheres containing petroleum vapour should be provided. The electrical installations should comply with Part IV of the Rules and these Instructions.

### **370. Funnel Dampers and Uptakes**

Funnel dampers should not, as a rule, be fitted; but, if fitted, they must be provided with a suitable device whereby they may be securely locked in the

fully open position, and there must be clear indication to show whether the dampers are open or shut.

Smoke-box doors should be shielded and well fitting, and casing and uptake joints made airtight.

### **371. *Instructions to Ships' Engineers***

A plan, suitably mounted, of the oil piping arrangements should be furnished for the guidance of ships' engineers. Written instructions regarding the system should also be provided, special attention being drawn to the following items:

- (a) The escape of oil fuel heated to or above the flash-point is most dangerous, and may result in an explosion or a fire.
- (b) After lighting the burners, the torches should on no account be discarded before they have been extinguished by means of the appliances provided for the purpose.
- (c) Cleanliness is essential to safety, and no oil or other combustible material should be allowed to accumulate in bilges and gutterways or on tank tops or boiler flats.
- (d) Before any oil tank which has contained oil fuel is entered for any purpose the oil should be entirely removed, and care should be taken that all oil vapour is also removed by steaming and by efficient ventilation. Tests of the atmosphere in the tanks or bunkers should be made to ensure safety before inspection or work in them is begun.

### **372. *Oil Fired Cooking Ranges***

Galleys equipped with oil fired cooking ranges should comply with the following requirements:

- (a) The galley should be properly ventilated.
- (b) The oil fuel tanks should be placed outside the galley, and the supply of oil to the burners should be capable of being controlled from the outside. The control position should be such that it will not be likely to be rendered inaccessible by a fire in the galley.

The tanks should be fitted with air pipes leading to the open air, in such a position that there will be no danger of fire or explosion resulting from the emergence of oil vapour when a tank is being filled. The open ends should be fitted with detachable wire gauze diaphragms which can readily be removed for cleaning.

Efficient means for filling the tanks and for preventing over-pressure should be provided.

- (c) The flash point of the fuel oil should not be less than 150° F.

## **OIL FUEL INSTALLATIONS. VESSELS OF CLASSES V, VI AND VI(A)**

### **373. *General***

The vessel must be kept free from waste oil. It must be seen that all vapour pipes and wire gauze diaphragms are in order and that fuel pipes and connections are oil tight. Fuel tanks should be removed for thorough examination and tested for tightness by hydraulic pressure periodically.

### **374. *Nature of Fuel***

Internal combustion engines should be driven by heavy oil, paraffin or other similar fuel and not by petrol, but where necessary to facilitate starting a small quantity of petrol, in general not exceeding 2 gallons per engine, may be carried, provided it is contained in a closed tank permanently connected to the engine.

### **375. *Motor Compartments. Construction, ventilation, etc.***

(1) If the motor or fuel tanks are situated below deck and oil of a flash-point lower than 150°F. is used the motor and fuel tanks should be enclosed in separate watertight and well ventilated compartments, in which no stove or other similar heating apparatus may be placed. Each compartment is to be furnished with at least two cowl ventilators one of which should be led well down into the space to prevent accumulation of vapour in the lower part. Any enclosed space within which a motor or fuel tank is placed should be ventilated in this manner irrespective of whether heavy or light oil is used as fuel.

In open vessels the spaces occupied by the motor and fuel tank should preferably be at the after end of the vessel and separated from the space allotted for the accommodation of passengers and crew by a substantial bulkhead as high as the seats and watertight up to at least half its height, to prevent the spread of oil to the passenger or crew space. If it is desired to place the motor amidships or forward either arrangement may be allowed provided that a bulkhead or casing, formed in the manner stated, is placed between the motor space and the passenger or crew space.

(2) Motors in open launches should be covered in, preferably by a suitable metal casing, but if the casing is of wood it should be lined with asbestos sheeting  $\frac{1}{4}$  inch in thickness faced with sheet metal. Consideration will be given to materials having equivalent fire and oil resisting properties.

Decked motor compartments in wood vessels should be similarly lined on the underside of the deck, on any wood bulkheads and on any exposed ship's side above platform level. Platforms should be of metal.

(3) If the vessel is of wood, a metal tray which can be readily cleaned and is of suitable depth is to be fitted under the motor: the bilges must be protected against saturation by oil.

### **376. *Fuel Tanks***

The fuel tanks must be substantially constructed of suitable material, no larger than is necessary and must be securely fixed in position. No part of the fuel tanks or their fittings is to depend on soft solder for tightness. Fuel tanks and their connections must be perfectly oil tight and tested by hydraulic pressure to a head of water of at least 15 feet.

Particulars of the tanks and fittings are to be submitted to the Engineer Surveyor-in-Chief if a pressure feed system is employed.

### **377. *Tray for Fuel Tanks***

A suitable metal or lead lined tray, from which any accumulation of oil can be readily removed, must be fitted under each tank to contain leakage or spillage from the tank or its connections.

### **378. *Arrangements for filling and Position of Fuel Tanks***

In order to minimise the risk of fire and explosion the arrangements for filling the fuel tanks are to be such that oil fuel or spirit will not spill or overflow either into the compartment containing the tanks or any other part of the vessel. Each fuel tank shall be fitted with a vapour discharge, i.e. air pipe as required by paragraph 361 of these Instructions.

If the tanks are filled through a wood deck, the woodwork surrounding the inlet pipe must be covered with sheet metal to prevent it becoming saturated with oil or spirit. A beading must be fitted at the edge of the sheathing to prevent the oil or spirit from spreading.

A properly secured wire gauze diaphragm or tube strainer, which can easily be taken off for cleaning and examination is to be fitted to each filling inlet and



at each vapour or oil outlet on the tanks and the filling pipe or orifice must have a suitable screwed cap.

Fuel tanks should not, as a rule, be fitted in the motor space, but should be placed in a separate compartment, or on deck, remote from the motor; a modification of this requirement will be granted only where the flash-point of the fuel exceeds 150°F. or in the case of small open vessels, where the machinery is fitted at the after end.

No loose cans of fuel oil or spirit are to be carried and the fuel tanks must not be filled when passengers are on board.

### *379. Pipe Arrangements*

The pipe conveying the fuel must be of seamless material made with easy bends and metal to metal joints. A cock is to be fitted at each end of the fuel pipe and no joint is to depend on soft solder for tightness. The joints and couplings are to be readily accessible. It must be possible to close any fuel tank outlet cock readily from a position outside the compartments containing the tank and the motor. This position must be such that it is not likely to be cut off in the event of fire in those compartments.

On engines using paraffin as fuel the air inlet pipe to the carburettor must be fitted with a wire gauze diaphragm and so arranged as to satisfy the Surveyor that there will be no danger of fire or explosion from escaping vapour when the engine is stopped, or from flame should a back fire occur.

## *Chapter 12*

### **STEERING GEAR**

#### *380. General*

(a) Under Rule 78(1) all ships must be provided with efficient main and auxiliary steering gear, but auxiliary steering gear is not required if a ship's main steering gear is fitted with duplicate power units and duplicate connections up to the rudder stock.

The duplicate connections referred to include duplicate electric leads to the power units and duplicate connections from the power units to the rudder stock. Where an auxiliary steering gear is fitted, the main gear, if electric, need not be fitted with the two sets of feeder cables referred to in Rule 38(4).

(b) Rule 78 also requires that the auxiliary gear should be capable of being rapidly brought into action and should be of adequate strength and of sufficient power to enable the ship to be steered at a navigable speed. The auxiliary steering gear must be operated by power in any ship which is fitted with a rudder stock of over 9 inches in diameter in way of the tiller.

Where a stock is fitted in excess of the minimum diameter required this latter diameter may be used in applying the above rule.

The main steering gear should normally be power operated in all ships of Classes I to III inclusive.

(c) The Rule further requires that means should be provided by which the ship can be steered from a position aft.

(d) In order to comply with the requirements for duplicate main gears, or main and auxiliary gears, two tillers, or their equivalent, are to be provided unless the working tiller is of special design and strength.

(e) The strength of the components of the auxiliary steering gear should not be less than would be required for a main steering gear, assuming the ship's speed to be not less than 12 knots.

(f) In small vessels of Classes IV to VI(A) inclusive, the provision of a spare tiller on or near the rudder stock will meet the requirement for auxiliary steering gear.

(g) All power operated steering gears should be fitted with arrangements for relieving shock.

Steam and exhaust pipes, hydraulic pipes and electric power cables for steering gears should be used exclusively for that purpose. Steam and exhaust pipes should be efficiently drained.

Fluid used in the hydraulic systems of steering gears should, when necessary, be non-freezing.

Any moving parts of the steering gear should be guarded so as to prevent possible injury to crew or passengers.

(h) Arrangements should be such that the man at the steering wheel has a clear view ahead when in the normal steering position.

(j) Surveyors should see by actual trial that when the top spokes of the steering wheel or wheels are moved to one side from amidships

(i) the rudder blade and any tell tale or indicator, moves in the same direction,

(ii) the angle of the rudder corresponds with the angle of the indicator and

(iii) any marking, port or starboard with their corresponding colours, refer to the direction in which the ship's head would turn when going ahead.

### **381. *Submission of Designs***

The designs of steering gears, including tillers or their equivalents, are to be submitted to the Engineer Surveyor-in-Chief. All parts are to be of ample strength in relation to the power of the gear and to the stresses which may arise when the rudder is struck by heavy seas.

### **382. *Surveys***

Steering gears are to be surveyed during construction; the tests of the material of the forgings and steel castings and hydraulic tests of ram cylinders, etc., are to be witnessed and the adjustment of the relief arrangements is to be checked.

At initial surveys, Surveyors, before issuing a declaration, should be satisfied with the behaviour of the ship when the helm is put hard over while the ship is running at full speed. The time taken to put the helm hard over, by means of the main steering gear, and the behaviour of the ship during the steering tests should be reported. In the case of passenger ships and launches having exceptionally high speeds relative to their dimensions, the angle of heel when the helm is put hard over while the ship is running at full speed should be ascertained and reported. The steering tests should include a trial of the auxiliary steering gear to ensure that it is sufficient to enable the ship to be steered at a navigable speed. The time taken to change over from the main gear should be reported.

At periodic surveys the steering gear is to be opened out sufficiently to enable the Surveyor to satisfy himself regarding the condition of all parts. An operating trial should be witnessed on both the main and the auxiliary steering gears.

## ***Chapter 13***

### **REFRIGERATING MACHINERY**

#### **383. *General***

Surveyors need only concern themselves with the precautions necessary to avoid unsafe conditions arising in the event of an escape of refrigerating medium, due to failure or defect in any part of the installation when in operation, or when repairs to the refrigerating machinery are being carried out.

**384. *Machines using ammonia***

These machines should be placed in well ventilated compartments isolated from the propelling machinery spaces.

**385. *Machines using carbon dioxide***

The escape of a moderate quantity of gas ( $\text{CO}_2$ ) from a carbon dioxide refrigerating machine situated in a well ventilated space is unlikely to be harmful.

A machine of this type may be placed in a well ventilated engine room if the charge, or portion thereof, which might be released by a breakdown of the machine, does not exceed 300 lb.

**386. *Machines using methyl chloride***

Machines using methyl chloride are not allowed.

## ***Chapter 14***

### **SPARE GEAR**

**387. *General***

Every ship of Classes I, II and II(A) must be provided with sufficient stores, spare gear and tools, having regard to the intended service of the ship, to enable running repairs to the ship's boilers and machinery to be made while the ship is at sea.

Where a duplicate unit is fitted additional to the minimum requirements the spare parts listed below need not be supplied.

For electrical spare gear see paragraph 146.

Stores should include assorted bolts and nuts, bar and sheet metal, jointing and gauge glasses.



388. *Number of Spares required*

Description of Spare Gear	Number of Spares Required	
	Ships of Class I	Ships of Classes II and IIA
<i>(a) Steam Reciprocating Engines for Propulsion</i>		
H.P. piston rings	One set including springs	As Class I
H.P. piston valve rings or H.P. poppet valves	One set including springs One valve of each size complete with rollers and springs	— —
Metallic packing for piston and valve rods	One set complete for each size of rod	—
Connecting rod top end bearing	One complete with bolts and nuts	As Class I
Connecting rod bottom end bearing	One complete with bolts and nuts	As Class I
Main bearing bolts and nuts	One set	—
<i>(b) Steam Turbine Engines</i>		
Rotor and gearing bearings	One complete bearing and two bolts or studs and nuts of each size and type	—
Turbine and gear case joints	One twentieth of the total number of bolts or studs and nuts of each size for each main joint on one engine	—
Gland packing rings	One complete set of each size and type	—
Turbine adjusting block liners	One set of each type of different thicknesses	As Class I
Turbine adjusting block rings or pads	One set of rings or pads of each size	As Class I
<i>(c) Heavy Oil Engines for Propulsion</i>		
Cylinder covers	One complete with valves, springs and fittings	—
Cylinder valves	One additional set for one cylinder complete with springs and fittings	One set for one cylinder complete with springs and fittings
Cylinder exhaust valves	Valves for half the cylinders of one engine including those mentioned above	One complete
Cylinder fuel valves	Additional fuel valves complete with springs and fittings for half the number of cylinders on one engine	Four additional fuel valves complete with springs and fittings
Cylinder liners	One complete	—
Cylinder liner joints	One set for each cylinder on one engine	—

Description of Spare Gear	Number of Spares Required	
	Class I	Classes II and IIA
Cylinder cover studs and nuts	One set for one cylinder	—
Piston (including exhaust piston valve where fitted)	One of each size complete with rings, studs and nuts	—
Piston rings	One additional set of each size	One set of each size
Piston rod	One for double acting engines only	—
Piston rod packing	One set for double acting engines only	—
Piston telescopic cooling pipes	One set for one cylinder	—
Connecting rod top end bearing	One bearing complete with bolts and nuts or one gudgeon pin and bushes	As Class I
Connecting rod bottom end bearing	One bearing complete with bolts and nuts	As Class I
Main bearing bolts and nuts	One set for one bearing	—
Cam shaft, scavenge blower and fuel pump drive	One set of wheels or six chain links, pins and rollers for each size fitted	—
Scavenge blower or	One set comprising rotor shafts and bearings	—
Scavenge pump		
Fuel pumps	One set of working parts for one cylinder	One quarter set suction and delivery valves As Class I
Fuel pipes	One length of delivery pipe of maximum length used complete with connections	As Class I
<i>(d) Heavy Oil Engines, for each size of Auxiliary Engine</i>		
Cylinder valves	One set of valves complete with springs and fittings for one cylinder and one additional exhaust valve	As Class I
Cylinder fuel valves	Additional fuel valves complete for half the number of cylinders	Four additional fuel valves complete with springs and fittings
Cylinder cover studs and nuts	One set for one cylinder	
Piston rings	One set for one piston	As Class I
Piston telescopic cooling pipes	Two sets for one cylinder	One set for one cylinder
Connecting rod top end bearing	One gudgeon pin bush	As Class I
Connecting rod bottom end bearing	One bearing complete with bolts and nuts	As Class I

Description of Spare Gear	Number of Spares Required	
	Class I	Classes II and IIA
Scavenge pump	One half set suction and delivery valves	One quarter set suction and delivery valves
Fuel pumps	One set of working parts for one cylinder	As Class I
Fuel pipes	One length of delivery pipe of maximum length used complete with connections	As Class I
<i>(e) Auxiliary Steam Engines; for Each Size of Engine</i>		
Connecting rod top end bearings	One bearing complete with bolts and nuts	As Class I
Connecting rod bottom end bearings	One bearing complete with bolts and nuts	As Class I
Piston rings	One set	As Class I
<i>(f) Pumps and Air Compressors</i>		
Pumps	One set of valves for the liquid end or one impeller and shaft for each size and type	As Class I
Air compressors	One set of rings for each size of piston and one set of suction and delivery valves of each size	As Class I
<i>(g) Propulsion Machinery of all types</i>		
Coupling bolts	One set for each size fitted	—
Main thrust blocks	One set of pads for one face of Michell type block or one thrust shoe	As Class I
<i>(h) Boilers for Main Steam or Essential Services</i>		
Safety valve springs	One for each size	As Class I
Main feed check valve lid	One	—
Tube stoppers or plugs	Twenty of each size including superheaters and economisers	Ten of each size
Fire bars or	One set for one furnace	As Class I
Oil fuel burner nozzles	One set complete with atomisers for one boiler	As Class I
Automatic feed regulator	One float of each size	—



## Chapter 15

### PERIODIC SURVEYS OF BOILERS AND MACHINERY

#### 389. Machinery

(a) *Main Engines.* In the case of ships with only one set of main engines, the complete machinery should be surveyed each year. In the case of ships with more than one set of main engines, the engines should be surveyed in rotation but only one set of engines, complete with its line of shafting and auxiliaries, need be surveyed in any one year.

(b) *Turbines.* No turbine supplied with steam from a high pressure water tube boiler need be opened up for survey more than once in four years in a ship with more than one set of main engines, and once in two years in a ship with only one set of main engines, provided that no abnormal conditions arise. The Surveyor should however still require any part of the machinery to be opened up, if, in his judgment, this is necessary. It will be necessary to work out a schedule of opening up of turbines, in consultation with the owners in respect of each ship to which these arrangements are to apply. The schedule will be submitted by the owners to the Principal Officer concerned, who will forward it, with the Surveyor's observations, to Headquarters for approval. It will then be attached to the ship's file, which will be called for in the usual manner by the Surveyor at any port at which the ship is under survey.

*Running Surveys.* The machinery of any ship may be surveyed on the running survey principle, that is, all turbines, cylinders, or other parts surveyed need not be opened up at the same time so long as the required proportion of the machinery is seen in the course of a year and the parts requiring annual survey are seen within 12 months of the last inspection. At these surveys the Surveyor should make a general inspection of the machinery not at the time opened up for survey.

*Notice to Surveyors.* Owners should make arrangements for Surveyors to be given ample notice when parts are to be opened up and should notify Surveyors when any breakdowns have occurred. Surveyors should keep records of the dates on which parts of the machinery have been surveyed.

*General.* To enable a proper survey to be made of all types of propelling machinery Surveyors should require all shaft bearings and thrust surfaces to be exposed, shafts to be turned for complete examination, essential pumps and all sea inlet and discharge valves in connection with machinery to be opened up and, when considered necessary, propeller shafts to be withdrawn. When the propeller shaft is replaced the Surveyor should be satisfied that the propeller has been properly secured. The spare gear should be examined.

Other inspections to be carried out at periodic surveys are given in the appropriate chapters.

In addition, the following parts of the propelling machinery should be opened up for survey:

- (i) *Reciprocating steam engines.* Cylinders, valve-chests, pistons, valves, relief valves, crossheads, piston rods, connecting rods and valve gear.
- (ii) *Steam turbines.* Turbine casings, relief valves, rotors and blading, and transmission gears.
- (iii) *Internal Combustion Engines.* Cylinders, pistons, valves, piston rods, connecting rods, crossheads, valve gear, air compressors, coolers, air receivers, air pipe system, safety devices and any transmission gears.

The Surveyor should satisfy himself regarding the efficiency of the cooling and lubricating systems.

Vessels of Classes V, VI and VIA should be tried with the Surveyor present for handiness in manoeuvring, going ahead, stopping and going astern, before any declaration is issued.

*Electrical Installations.* When surveying electrical propelling machinery, the Surveyor should examine any records of insulation resistance readings of the various circuits kept by the ship's engineers and the records of temperature conditions of the machinery which have been experienced in service.

He should satisfy himself regarding the condition of the stators and rotors and their windings and the electrical connections, commutators, slip rings, etc. The control gear and safety devices should be examined.

Where water circulated air coolers are fitted they should be examined and, if necessary, subjected to a suitable hydraulic test.

Surveyors should satisfy themselves that routine testing and overhauling of generators, motors and other electrical parts of essential auxiliaries and electrical installations generally is carried out and recorded. (See also Part IV of the Rules and Part IV of these Instructions).

### **390. Boilers and other Steam Generators, Superheaters and Economisers**

(a) Every boiler must be examined at intervals of not more than 12 months. In the case of passenger ships with more than one boiler, the boilers need not be surveyed at the same time but may be surveyed in rotation on the running survey principle, providing every boiler is surveyed every twelve months.

(b) Boilers under survey, together with their mountings, should be opened up completely for examination.

(c) Surveyors may at any time require the removal of brickwork or other obstructions, to facilitate the internal and external examination of a boiler, but, in general, brickwork need not be specially removed during the first four years provided there is no evidence of local leakage or corrosion.

(d) The Surveyor should make a thorough examination at every survey of a boiler, and, when he considers it is necessary, parts should be drilled to ascertain the thickness of the plates. When, however, a boiler is of such dimensions or form that a satisfactory internal examination cannot be made, it should be examined as far as possible and tested by hydraulic pressure (see paragraph 247) at every survey.

NOTE. A Surveyor, before entering a boiler, must be satisfied with the precautions taken to prevent admission of steam to the boiler. If a boiler is not sufficiently cleaned or is too hot for efficient examination to be made the Surveyor should decline to examine it.

(e) A boiler so placed in a ship that the bottom of the boiler cannot be examined should be lifted for inspection as the Surveyor may require, but not less frequently than once in four years. Before replacement it should be tested by hydraulic pressure (see paragraph 247).

(f) After important repairs have been carried out on a boiler, or at any time he considers it is necessary, a Surveyor may require the boiler to be tested by hydraulic pressure.

(g) A working pressure allowed in respect of a boiler should not be increased without the authority of the Engineer Surveyor-in-Chief.

(h) Every case in which the pressure allowed on the boilers of a passenger ship is reduced for any reason should be reported to the Engineer Surveyor-in-Chief.

(j) Evaporators, superheaters and economisers, etc., should, in general, be treated in a similar manner to boilers.

### **391. *Repairs to Boilers by Welding***

(a) Before repairs by welding are undertaken the agreement of the Surveyor should be obtained. The Surveyor should be satisfied that the repair is one which may properly be made by welding and that a process recognised by the Ministry will be used. Welding processes recognised by the Ministry of Transport for effecting boiler repairs are the metal arc process with covered electrodes or any other electric arc process in which the arc stream and the deposited weld metal are shielded from atmospheric contamination.

(b) Repairs by welding processes should not be made to cylindrical boiler shells the failure of which at the welded part might have disastrous results.

(c) Welding processes recognised by the Ministry may be employed, within limits, for repairing furnaces, end plates and combustion chamber plates, for the attachment to these parts of new pieces of plate replacing defective portions and for re-inforcing the landing edges of riveted joints except the longitudinal joints of boiler shells.

(d) When proposed welding repairs are of an uncommon or extensive character, or proposals are made to effect repairs by welding in respect of boiler plates having carbon content of 0.3 per cent. or more, full particulars should be submitted to the Engineer-Surveyor-in-Chief.

(e) After completion of repairs of an important character by welding the boiler should be hydraulically tested, the welds being hammer tested whilst the pressure is maintained (see paragraph 290).



## PART VII

# Miscellaneous

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### COMPASSES. Rule 81

#### **392. *Standard Compasses***

It is recommended in Ministry Notice No. M.345 that every new magnetic compass intended for use as a standard compass on ships of Classes I to III, inclusive, should, before installation, be tested at the Admiralty Compass Observatory, Slough. If the compass complies with the official specification, the Admiralty Compass Observatory will issue a certificate to that effect. Where, therefore, a new magnetic compass is fitted as a standard compass on any ship of Classes I to III, inclusive, the Surveyor should enquire whether the compass has been tested and, if so, inspect the certificate and note the number and date of the certificate on his declaration.

#### **393. *Steering Compasses and other Additional Magnetic Compasses***

It is also recommended in that Notice that all new magnetic compasses, other than those intended for use as standard compasses, should be of patterns, specimens of which have been type-tested at the Admiralty Compass Observatory.

#### **394. *Binnacles***

Similarly, it is recommended that all binnacles intended for use with magnetic compasses should be of patterns which have been type-tested by the Admiralty Compass Observatory.

#### **395. *Satisfactory Types of Magnetic Compasses and Binnacles***

Lists of types of magnetic compasses and binnacles which have been tested and found satisfactory in accordance with paragraphs 393 and 394 will be issued periodically for the information of Surveyors.

#### **396. *Siting of Magnetic Compasses***

The siting of magnetic compasses in relation to structures or fixed objects made of or containing magnetic material is of first importance. Whenever possible, such structures or objects should not be fitted within 10 feet of a standard compass or within 5 feet of a steering compass. In the case of units of radar sets which contain magnetic material, the above distances or the minimum "safe distances" marked on the sets, whichever is the greater, should be maintained where practicable. Fittings with doors, drawers, etc., made of magnetic materials, opening in the direction of the compass should be so sited that the distances are not below the minimum when the doors, drawers, etc., are fully opened. Whenever electrical instruments are placed near a magnetic compass, care should be taken to see that they do not affect the compass when they are switched on.

#### **397. *Adjustment of Compasses***

(a) Under Section 285(1) of the Merchant Shipping Act, 1894, every sea-going passenger ship is required to have her compasses adjusted from time to time to



### 399. *Delay in obtaining Compass Certificate*

(a) If the master of a ship has been unable to procure a certificate of the adjustment of compasses, and the omission does not appear to be due to any negligence or fault of the master or owner, or if there is a delay in obtaining the certificate of the master and mate required by paragraph 398, and there is no reason to believe that they will refuse to sign the certificate or that the owners will decline to attest it, the Surveyor may issue the declaration without the required certificate. In such cases, however, the fact should be noted in the appropriate space on the declaration and the Surveyor should specify which of the two certificates is required. Headquarters will, upon receipt of the declaration from the owners, instruct the Superintendent of the Mercantile Marine Office to whom the passenger certificates or passenger and safety certificates are forwarded, to withhold them until the required compass certificate is produced. In such a case the Superintendent is to forward the compass certificate to the Surveyor for his information. The Surveyor should send the certificate to Headquarters.

(b) When a ship is to leave port for the adjustment of compasses and then proceed direct on the voyage, the Surveyor is to obtain a certificate, form Surveys 23A, signed by the master and mate, and countersigned by the owner or his superintendent, to the effect that the ship will not proceed on the voyage until the compasses have been adjusted to the satisfaction of the master and mate and a certificate of adjustment furnished, together with a table of residual deviations.

This certificate is to be attached to the declaration in the same manner as a master's and mate's compass certificate. The compass adjuster's certificate must be sent to the Surveyor within three days of sailing and he should send it on to Headquarters.

## DEPTH-SOUNDING DEVICES. Rule 82

### 400. *Mechanical Depth-Sounding Devices*

The mechanical depth-sounding device to be provided in accordance with Rule 82(1) is in addition to any echo-sounding apparatus which may be fitted on the ship. The Surveyor is to ensure that sufficient spare parts are provided on board having regard to the type of the device and the intended service of the ship.

### 401. *Lead-Lines*

The hand lead-lines provided in accordance with Rule 82(2) should be marked as follows.

At	2 fathoms	a piece of leather split in two strips
"	3	" " " three "
"	5	" " white calico
"	7	" " red bunting
"	10	" " leather with a hole
"	13	" " blue serge
"	15	" " white calico
"	17	" " red bunting
"	20	" a strand with two knots tied in it.



#### 402. *Submission of Details*

In the case of new passenger ships and ships requiring passenger certificates for the first time full particulars of the proposed anchors and chain cables should be submitted to the Engineer Surveyor-in-Chief. The details for new ships can be taken from the midship section plan if necessary.

#### 403. *Surveys*

At the initial survey and at each annual survey Surveyors should inspect the statutory test certificates of all the anchors and chain cables. When these cannot be produced Surveyors may accept the anchors and chain cables if they are quite satisfied that they have been proved in accordance with the requirements of the Anchors and Chain Cables Act, 1899 and if the proof marks are in order. In any case of doubt a report should be sent to the Engineer Surveyor-in-Chief.

The chain cables should be removed from the chain lockers at least once in 12 months and cleaned, if necessary. The pins should be knocked out of the shackles or joining links. The cables, shackles or joining links, pins and anchors should be examined to see that they are in good condition. Chain cable should be renewed when it has worn an amount equivalent to about 20 per cent. reduction in its strength.

#### 404. *General*

Anchors and cables may be accepted if they comply with the requirements of Lloyds Rules. Surveyors should also see that the anchors and chain cables of every ship they survey are duly certified under the Anchors and Chain Cables Act of 1899. Where stream or kedge anchors are carried, they must be tested in accordance with the Act if they exceed 168 lb. in weight including stock.

The shackle pins or removable parts of joining pins should be secured by small pins of non-corrodible metal or hard wood, which should be well fitted and of proper taper, suitably locked and capable of removal when required. The tools required to remove these pins expeditiously should be readily available on the ship at all times.

The spare bower anchor should be stowed where it will be readily available when required.

Surveyors are to satisfy themselves when the opportunity arises that the chain cables are efficiently secured in the chain locker. It is not considered necessary to lay down a rule as to what method of securing should be adopted but the method should allow of the cable being slipped expeditiously. The use of manilla rope or small chain lashings should be discouraged.

#### 405. *Means of Escape. Rule 85*

In ships of Class I the minimum aggregate width of ladderways and stairways giving access to the lifeboat embarkation deck is to be determined as follows:

Stairways which provide access towards the lifeboat embarkation deck.

- (i) from any compartment, should have an aggregate width of not less than two inches for every five persons appropriate to the compartment;
- (ii) from two compartments, one above the other, should have an aggregate width of not less than two inches for every five persons appropriate to both compartments;
- (iii) from three compartments, one above the other, should have an aggregate width of not less than two inches for every five of the largest two numbers of persons appropriate to any two compartments, plus one inch for every five persons appropriate to the other compartments;

- (iv) from four compartments, one above the other, should have an aggregate width of not less than two inches for every five of the largest two numbers of persons appropriate to any two compartments, plus one inch for every five of the next largest number appropriate to any compartment, plus half an inch for every five persons appropriate to the other compartment;
- (v) from five or more compartments, one above the other should have an aggregate width of not less than that determined in accordance with the preceding sub-paragraph (iv) for the four consecutive decks which give the greatest width.

The number of persons appropriate to any compartment is normally to be taken as the number of sleeping berths in it for passengers and stewards plus two thirds of the number of berths in it for other members of the crew.

Special provision is necessary in the sections of a ship containing dining rooms and in such sections the width of ladderways and stairways providing access towards the lifeboat embarkation deck is to be the greater of the following two calculations:

- (i) Assume the dining room full to seating capacity with stewards in attendance, two-thirds of the remaining passengers and crew in their berths and one-third in public rooms and working spaces throughout the ship, and allow one and half inches for every five persons, subject to relaxation as referred to in sub-paragraphs (iii), (iv) and (v) above.
- (ii) Assume all passengers and stewards and two-thirds of the remainder of the crew to be in their berths and allow two inches for every five persons, subject to relaxations as referred to in sub-paragraphs (iii), (iv) and (v) above.

In general, except in those sections of a ship that contain dining rooms, the number of persons likely to use public rooms need not be considered, but the Ministry will consider specially the widths of ladderways and stairways from such places if it appears that undue congestion might arise.

Above the bulkhead deck, compartments may in suitable ships be regarded as extending from end to end of the ship provided that the ladderways and stairways are reasonable in number and effectively distributed so as to avoid congestion at any part.

Practicable means of access shall be provided between the embarkation deck and the weather decks at the ends of the ship.

General requirements for ladderways and stairways are:

- (i) They should not be less than 30" wide nor more than 60" wide unless fitted with an intermediate rail. The width is to be measured on the tread within the sides or between the handrails, whichever is the less.
- (ii) They are to be fitted on each side with efficient hand-rails and well lighted by day and by night.
- (iii) They should, as far as possible, be pitched forward and aft, and not athwartships.

For ships of Classes II to VIA, especially those on which a substantial number of deck passengers are to be carried, the widths of stairways and ladderways required by Rule 85 will be specially considered at headquarters.

In all cases plans showing the stairways, ladderways and other escapes should be submitted by the Surveyor to the Chief Ship Surveyor at an early stage.

It is especially important to see that adequate escapes to open decks are provided in ferries and excursion steamers carrying large numbers of deck passengers in enclosed spaces. There is a tendency on some ships of this type to arrange a large proportion of the passenger accommodation in enclosed spaces and for passengers to crowd into sheltered spaces in bad weather. In

these circumstances the normal exits may be blocked. Surveyors should obtain from the builders and forward to the Chief Ship Surveyor as early as possible a general arrangement plan showing the spaces available for passengers, the approximate number of passengers for which each space would measure, the widths of ladderways and doorways, and of windows which might be available as supplementary escapes.

**406. Guard Rails and Stanchions and Bulwarks. Rule 86**

In order to comply with Rule 86, passenger ships should be provided with guard rails and stanchions and bulwarks as follows:

*Ships of Class I*

Where guard rails and stanchions are fitted the top of the uppermost rail should be not less than 3' 6" high, and the rails should be not more than 9 inches apart, unless strong netting is provided. Where bulwarks are fitted they should be at least 3' 6" high and the freeing ports therein should be fitted with suitable grids for the protection of persons on board.

The height of the rails is to be taken as the distance measured from the top of the uppermost rail to the top of the deck at a point vertically below the inner edge of the rail, or, if the deck has a waterway, to the top of the deck plank next to the waterway.

**407. Ships of Classes II and II(A)**

The requirements of paragraph 406 apply subject to the following modifications:

- (i) All parts of the freeboard deck to which passengers have access should be fitted with bulwarks not less than 4 feet in height. Other parts of the freeboard deck and decks above the freeboard deck should be provided with guard rails and stanchions or bulwarks not less than 3' 6" in height.
- (ii) Weather cloths should be fitted to all guard rails on decks to which passengers have access. Where, however, having regard to the height above water, the owner does not propose to fit weather cloths, particulars should be forwarded to the Chief Ship Surveyor for consideration.

**408. Ships of Class III**

The requirements of paragraph 406 apply except that, if any portion of the main deck or raised quarter deck to which passengers have access is fitted with guard rails instead of close bulwarks, weather cloths should be provided for the rails.

**409. Decked Ships of Classes IV, V, VI and VI(A)**

The height of the bulwarks or of the uppermost guard rail, whether on the main deck or bridge deck, should be not less than that shown in the following table and, unless strong netting is provided, the rails should be not more than 9 inches apart:

Registered length of ship	Height of uppermost rail or bulwarks					
	Class IV		Class V		Class VI and VI(A)	
	<i>Ft.</i>	<i>ins.</i>	<i>Ft.</i>	<i>ins.</i>	<i>Ft.</i>	<i>ins.</i>
Under 50 feet	2	9	2	6	}	3      3
50 feet and under 70 feet	2	10	2	8		
70      "      "      90      "	3	0	2	10		
90      "      "      130      "	3	2	3	0		
130      "      "      170      "	3	3	3	2		
170 feet and over	3	4	3	3		



If, in the case of ships of Classes IV and V, the fitting of guard rails or bulwarks to the required height would interfere with the employment of the ship (e.g. passing under a bridge), the case should be submitted to the Chief Ship Surveyor for instructions.

**410. *Open or Partially Decked Ships of Classes I', I'1 and I'1(A)***

Any partial deck to which persons on board have access should be provided with guard rails and stanchions or bulwarks in accordance with paragraph 409.

In the open parts of partially decked ships, and in open ships, the top of the covering board or of the wash strake, or the upper edge of the coaming of the half-deck, should be not less than 30 inches above the flooring boards if the ship does not exceed 20 feet in length, and 36 inches if the ship is 40 feet or over in length. For ships of lengths between 20 feet and 40 feet, the height should be in proportion. When the height from the top of the covering board, etc., is less than that stated above, a wash-board or rail should be fitted above the covering board, etc., in such a position that the top of the wash-board or rail is at least the required height above the flooring boards.

**411. *Acceptance of Equivalent Arrangements.* Rule 87**

If the owner or shipbuilder of a passenger ship proposes to adopt any alternative method of construction of the hull and machinery, or to provide alternative equipment or apparatus, to that required by the Rules, the proposals are to be forwarded to the Ministry for consideration. Unless the alternative construction, machinery or equipment proposed is at least as effective as that required by the Rules, its adoption will not be sanctioned.

## PART VIII

# Passenger Accommodation

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### *Chapter I*

#### FOREIGN GOING PASSENGER SHIPS

##### CLASS I SHIPS

#### **412. General**

The following instructions apply to new passenger ships, other than ships subject to the emigration requirements of the Merchant Shipping Act, 1894.

#### **413. Position of Passenger Accommodation**

Passengers must not be carried on more than one deck below the waterline and berthed passengers must not normally be accommodated within one-eighth of the registered length of the ship from the fore side of the stem.

Lamp rooms, paint rooms and spaces used for the storage of inflammable oils must not communicate directly with passenger accommodation by doors or passageways, or be so situated as to be in any way a danger to passengers.

Passengers must not be berthed or accommodated in a space adjoining an oil fuel bunker unless the space is separated from the bunker by an additional steel vapour-proof bulkhead, so arranged that the space between the two bulkheads is well ventilated and accessible. If, however, the bunker bulkhead is of all welded construction the additional bulkhead need not be fitted. Passenger accommodation may however be situated on a deck forming the crown of an oil fuel space provided the deck is oiltight, the passenger spaces are especially well ventilated and contain no manholes or openings to the oil fuel spaces and the flooring is of a material and thickness approved for such positions.

Where passenger accommodation is adjacent to cargo spaces, coal bunkers, store rooms, lamp rooms, paint rooms or spaces used for the storage of inflammable oils, it must be separated from such spaces by gas-tight steel bulkheads and decks. (See also Chapter 13 of Part VI of these Instructions).

#### **414. Lighting, Ventilation and Heating**

All passenger accommodation must be efficiently ventilated and lighted during both day and night. Natural lighting should normally be provided where circumstances permit. If, however, the Surveyor is satisfied that natural lighting in any space is impracticable, such space may be accepted for the accommodation of passengers if suitably lighted by artificial means. Spaces in which provision is not made for sufficient light and air in all circumstances should not be accepted for the accommodation of passengers.

Passenger accommodation must be fitted with efficient heating arrangements, but if the owner considers that heating arrangements are not necessary in the service in which the ship is to be engaged, the Surveyor should submit the case to the Chief Ship Surveyor for instructions.

#### **415. Drinking-Water Tanks**

Drinking water must be effectively protected against contamination. The

overflow pipes from drinking water tanks should in no case be allowed to discharge into the bilges and the air pipes should be led to a position clear of possible contamination. The upper ends of filling pipes should not terminate flush with a deck but should be carried up well clear of the deck.

Surveyors should examine the sewage and sanitary arrangements during cleaning of the system for possible leakage or overflow which might cause contamination of the drinking water. Sewage tanks should be situated so that leakage or overflow from them cannot pass into drinking water tanks. In no case should a manhole to a drinking water tank be situated in a sewage tank space. Sewage tank compartments should not be contiguous to any drinking water tank.

**416. *Sheathing of Steel or other Metal Decks***

Steel or other metal decks forming the floors or crowns of enclosed spaces in which passengers are accommodated should be sheathed with wood or with an approved composition (see Circular 1950). Crowns of passenger accommodation which are exposed to the weather should be sheathed with wood 2½ inches thick, or with an equivalent composition.

**417. *Water Closets***

If the Surveyor is in any doubt as to the adequacy or efficiency of the arrangements, particulars should be submitted to the Chief Ship Surveyor.

**418. *Washing Facilities, Dining Rooms, Recreation Rooms or Lounges, Ready-Use Baggage Rooms, Airing Space and Hospitals (Main and Isolation)***

These facilities should be available to all passengers. If the Surveyor is in any doubt as to the adequacy or efficiency of the arrangements, particulars should be submitted to the Chief Ship Surveyor. For airing space see also paragraph 420(b).

**419. *Number of Passengers***

The number of properly constructed fixed berths fitted for passengers determines the number of passengers to be allowed in each class (other than fourth class passengers) if a reasonable amount of floor space in the sleeping rooms for each passenger is provided. There should not be more than two tiers of berths in any cabin. The total space excluding airing space allocated for the exclusive use of passengers must be such as to provide at least 36 clear superficial feet per passenger. In assessing the total space, the Surveyor may include all enclosed spaces such as saloons and recreation rooms, etc., allocated to each class.

Small berths suitable for children may be permitted if an owner so desires, on condition that the total space allocated for the exclusive use of these passengers is at least 36 clear superficial feet for every two children allowed, and the berths are at least of the following dimensions:

Age of Child	Size of Berth
1-3 years	3 ft. 6 in. × 1 ft. 4 in.
3-8    "	4 ft. 6 in. × 1 ft. 6 in.
8-12   "	5 ft. 3 in. × 1 ft. 8 in.

In every case the Surveyor must be satisfied that there is no danger of a child being thrown out of a berth by the motion of the ship. The declaration must indicate the number of adults and children which the ship is fit to carry.



## 420. *Fourth-Class Passengers*

Fourth-class passengers may be carried on foreign-going passenger ships, on coasting voyages only, between ports in Africa and in Asia, or ports in South and Central America or in the West Indian Islands, under the conditions indicated below. Particulars of the voyages and the seasons should be submitted to the Chief Ship Surveyor. The passengers may be unberthed, or on suitable voyages, carried on deck.

### (a) *Number of Passengers*

The number of fourth-class passengers to be allowed for any space below the weather deck should be determined by dividing the clear area of the deck in square feet by 15.

If it is proposed to carry deck passengers on decks exposed to the weather, full particulars must be submitted to the Chief Ship Surveyor. The number of passengers to be allowed for any space on such decks should be determined by dividing the clear area of the deck in square feet by 12. The points between which the deck breadths are to be taken and the interpretation of the words "clear area" should be as specified in paragraph 425. No part of a forecastle deck may be included in the measurements, and if the ship has no forecastle the foremost ordinate of the space measured shall not be nearer the foreside of the stem than one eighth of the ship's registered length. No space which is required for working the anchors or the boats or for purposes of navigation may be included, nor may deck space be measured over which the berthed passengers require to pass in going from their quarters to the water closets or to the airing space set apart for their use. The aggregate length of all the spaces measured for unberthed passengers, whether below or above the weather deck must not exceed the registered length of the ship.

Deck houses should not be measured for passengers unless they form part of the permanent structure of the ship.

### (b) *Airing Space*

Airing space is to be set apart, either on the upper deck or on a poop or bridge deck, for the use of all the passengers except deck passengers, on the scale of 24 square feet for each passenger other than fourth-class passengers, and 6 square feet for each fourth-class passenger accommodated below the weather deck. These spaces must not be included in the area available for deck passengers.

### (c) *Lighting, Ventilation and other Requirements*

Spaces below the weather deck should not be included in the measurements for fourth-class passengers unless they are suitably lighted and ventilated, having regard to the special circumstances of the intended coasting voyage, and have adequate entrances and exits.

The surface of unsheathed steel decks may be included in the measurements, provided the Surveyor is satisfied that the weather conditions within the intended limits are not likely to be such as to cause hardship to the fourth-class passengers carried on the unsheathed decks.

### (d) *Closets*

Suitable closets fitted with an efficient water service should be provided for the exclusive use of the fourth-class passengers. When female passengers are carried, separate closets are to be provided for their use. If separate closets are not provided, the Surveyor should state in his declaration that only male fourth-class passengers may be carried.

**(e) Watertight Subdivision and Life-Saving Appliances**

The Statutory Rules and Instructions regarding watertight subdivision and life-saving appliances must be complied with.

**(f) Declaration**

The Surveyor should state in his declaration the number of fourth-class passengers and the limits of the voyage within which they may be carried. Deck passengers will not be allowed on any voyage which extends further north or south than latitude 50° in summer and latitude 40° in winter, unless all particulars have been submitted to and approved by the Chief Ship Surveyor.

**(g) A clearly legible painted notice in the following terms should be displayed in each space measured for deck passengers during the period the passenger certificate is in force:**

“The deck from this mark to the ..... contains ..... square feet and is certified for ..... fourth-class passengers, when not occupied by cattle, cargo or other encumbrances.

When cattle, cargo or stores are carried in this space the number of passengers is to be reduced by one for every twelve square feet so occupied.”

## **Chapter 2**

### **HOME TRADE PASSENGER SHIPS**

#### **CLASS II AND IIA SHIPS**

**421. General**

The following instructions and the requirements of paragraphs 413 to 415 inclusive apply to new passenger ships of Classes II and II(A) and are to be applied to existing passenger ships of these Classes so far as is reasonable and practicable.

**422. Plans and particulars required**

To ensure uniformity of practice in dealing with the measurement of passenger spaces, cabins and shelters and the provision of water-closet accommodation in these ships, form Surveys 8A must be completed by the Surveyor and forwarded to the Chief Ship Surveyor for every home trade passenger ship coming under survey for the first time or whenever the passenger numbers are altered. The form should contain all the dimensions taken in the measurement of passenger spaces and state the number of passengers and where carried, the amount of shelter space provided and the number of water-closets, showing their position and indicating which are set aside for the use of women and children and which for the crew. The form should also show the number and position of the fixed berths or sofas constructed for sleeping berths, when these are provided, and the Surveyor should report whether each passenger so accommodated has at least 72 cubic feet of space (see also paragraph 424).

Where the passengers comprise two or more classes, the form should show the allocation of the accommodation to the different classes and the number of each class. (See also paragraph 435).

The form, after being examined and approved, will be returned to the

Surveyor who should return it on completion of the case to the Chief Ship Surveyor, to be kept with the other records of the ship.

#### **423. *Compartments and decks allowable for passenger measurement***

The Surveyor should only measure spaces which he considers are proper for the accommodation or carriage of passengers.

Not more than three decks, including the tops of deck houses are to be measured for passengers, without special permission from the Chief Ship Surveyor.

Portions of any decks which extend beyond the sides or ends of supporting deck houses or beyond the main hull of the ship or are carried only on stanchions or frames, may be measured only if the Surveyor is satisfied that the structures are of sufficient strength and fit for the carriage of passengers. Details of such spaces should be reported on form Surveys 8A.

Where passengers are allowed access to the tops of deck houses the Surveyor should satisfy himself that such structures are of sufficient strength whether or not the spaces are measured for passengers.

That portion of a compartment or of a deck used for the purpose of navigation is not to be included in the passenger measurements.

Forecastle decks must not be included in the measurements, and, in the case of ships having the bridge house joined to the forecastle or having a complete promenade deck, the foremost ordinate of the space measured must not be nearer to the fore side of the stem than one-eighth of the ship's registered length.

In paddle-wheeled ships neither the sponsons nor the tops of houses upon the sponsons may be included in the measurements for passengers.

When there are deck houses and the space between the side of the deck house and the bulwark or rail is less than 2 feet 6 inches in width, the space must not be measured for passengers.

Passageways may not, in general, be measured for passengers. Where, however, a ship has wide passageways and the Surveyor considers that a part of them might properly be measured for passenger accommodation, particulars should be submitted to the Chief Ship Surveyor for instructions.

In well-deck ships, the deck spaces between the forecastle and raised quarter deck, bridge house, or poop, as the case may be, must not be included in the measurements for passengers unless the deck is, in the opinion of the Surveyor, sufficiently high above the water, as indicated by the load line, to render it fit for passenger accommodation.

The approximate freeboard at the lowest part of the "well-deck" measured for passengers should in all cases be stated in form Surveys 8A.

Provision for stowing luggage should be made outside the passenger accommodation. Racks or similar convenient stowage should be provided for hand luggage taken into accommodation. The luggage should not be permitted to block stairways, escapes, alleyways or other exits and entrances which will be needed in an emergency. Where other provision has not been made the Surveyor should agree with the owners on parts of the accommodation where luggage may be stowed and these parts should be excluded from passenger measurements.

#### **424. *Number of passengers allowed in enclosed spaces.***

The number of passengers allowed in cabins and compartments fitted with either fixed berths or sofas constructed for sleeping berths should be determined by the number of berths, provided there is 72 cubic feet of space for each passenger and the berths are in not more than two tiers. Where, however, the



owner desires a compartment in which sofa berths are fitted to be assessed on an area basis this will be considered provided the owner gives a guarantee that the number of passengers allowed in the compartment will not be restricted below that assessed on an area basis, by making a charge or otherwise. All such cases should be submitted to the Chief Ship Surveyor for instructions.

The number of passengers allowed for lounges and smoke rooms should be obtained by dividing the clear area in square feet by nine. In assessing the clear area, the space occupied by tables and permanent fittings should be deducted. When fixed seats are fitted, the measurements should be taken from the back of the seats. If seats are not fitted, the measurements should be taken on the floor of the space.

The number of passengers allowed for dining saloons where meals with full table service are served should normally be the number for whom seats are provided.

Dining saloons should not be measured for passengers unless the Surveyor is satisfied that they will be kept open when passengers are on board, and full numbers are being carried.

#### **425. *Number of Passengers on Open Decks***

The length of the deck should be measured between points within which the Surveyor considers the area fit for the safe and proper accommodation of passengers. The breadths should be taken from the inner edge of the gutter waterway or raised covering board, or inner edge of the rail whichever is furthest inboard.

The number of passengers allowed should then be determined by dividing the clear area of the deck in square feet by nine.

*Clear area* means the area which remains after that occupied by all encumbrances, such as hatchways, skylights, companions, machinery casing, wheel, windlass, binnacles, masts, ventilators, navigating space, dunnage for luggage, boats carried inboard, fittings for cattle, etc., has been deducted.

#### **426. *Seating***

Seats, either fixed or portable, e.g. folding chairs, should normally be provided for all passengers in excess of the number of passenger berths provided. The seating capacity of fixed seats should be assessed on the basis of 1 ft. 6 ins. per person.

#### **427. *Airing Space***

- (a) In ships requiring Passenger and Safety Certificates Class II or Class II(A) Passenger Certificates for home trade voyages on which the time between leaving one port and arriving at the next exceeds 10 hours, promenade or airing space for each class at the rate of three square feet per passenger is to be reserved on deck for the total number of passengers accommodated in enclosed spaces. This space is not to be included in the area measured for deck passengers.
- (b) In ships requiring Passenger and Safety Certificates Class II or Class II(A) Passenger Certificates for home trade voyages on which the time between leaving one port and arriving at the next does not exceed 10 hours, airing space is not required.

#### **428. *Shelter for Passengers.***

Sheltered spaces for each class sufficient to accommodate all passengers of that class must be provided at the rate of six square feet per person for the period from 1st November to 31st March or the Friday before Good Friday

(whichever is the earlier) and at all other times at the rate of three square feet per person. Cabins and compartments fitted with berths may only be counted as shelter for the number of persons for whom berths are provided unless the Surveyor is satisfied that larger numbers will be allowed to use these spaces.

“Sheltered spaces” means spaces entirely closed in or open at their after end only.

Where owners desire to carry, within the total numbers allowed by the Passenger Certificate, more second or third class passengers than the measurements provide for, sufficient first-class sheltered accommodation should be provided as far as practicable for the additional second or third class passengers. (See also Paragraph 435).

In providing enclosed accommodation and adequate sheltered spaces for deck passengers due regard should be had to the requirements of Rule 85(4) which provides that “in every ship of Classes II and II(A) such means of escape shall lead to the lifeboat embarkation deck and to an open deck of sufficient area having regard to the number of persons whom the ship may carry”.

#### **429. *Limitation of Total Number of Passengers by Gross Tonnage.***

The number of passengers allowed in any Class II or Class II(A) ship must not exceed the number denoting the gross tonnage of the ship.

#### **430. *Stability***

The Surveyor should not state in his declaration that a ship is fit to carry a specified number of passengers unless he is satisfied that the ship has sufficient stability and freeboard to carry that number safely.

In addition to the requirements of paragraph 120, a calculation should be submitted to the Chief Ship Surveyor showing the angle of heel which would occur with two-thirds of the passengers distributed on one side of the ship and one-third on the other side. For the purpose of this calculation the ship should be assumed to be in the worst stability condition likely to be experienced on the intended service. The passengers should each be represented by a weight of 140 lb., and should be assumed congregated at three square feet per person on the uppermost deck or decks to which they have access. The centre of gravity of the passengers should be assumed to be 2 feet 6 inches above the deck.

#### **431. *Sheathing of Steel or other Metal Decks***

The floors and crowns of enclosed spaces in which passengers are accommodated must comply with the requirements of paragraph 416 but wood sheathing less than 2½ inches thick may be allowed on exposed decks forming the crowns of passenger accommodation with the approval of the Chief Ship Surveyor. Between the 1st November and 31st March inclusive, passengers may not be carried on steel or other metal decks which are exposed to the weather unless these decks are covered with wood or an approved composition.

#### **432. *Water Closets and Urinals***

When forwarding form Surveys 8A to the Chief Ship Surveyor for examination, the Surveyor should report how many classes of passengers are carried. If the passengers are all of one class, all the male passengers should have access to any w.c. marked for men, and all the female passengers should have access to any w.c. set apart for women.

The number of w.cs. provided free of charge for each class should not be less than on the following scale:—

Up to 50 passengers	—	2 w.cs.
51 to 100 passengers	—	3 w.cs.
For each additional 100 or part of 100 passengers—		1 w.c.



A urinal or an extra w.c. should also be provided for every 100 or part of 100 passengers.

A fair proportion of the w.cs. must be set apart for use by women and children only, and so marked outside. Where such w.cs. are entered from a deck or compartment which is used by male passengers and crew the arrangements should ensure privacy. Clear passageways to the w.cs. must always be maintained.

The w.cs. should be large enough, clean, well lighted, ventilated and drained, and effectively protected from weather and sea.

W.cs. and urinals erected on deck for the exclusive use of passengers and exempted from inclusion in the ship's tonnage as allowed by the "Instructions as to Tonnage Measurement", must be permanently and conspicuously marked outside to indicate their purpose and that they are for "passengers only".

#### **433. *Arrangements and Deductions necessary when vehicles, cattle and cargo are carried***

##### ***On the Open Deck.***

When cattle are carried on the open deck, the space they occupy must be effectively shut off from the passenger spaces by bulkheads, wooden partitions or similar means. The partitions need not be close but efficient washboards to prevent dung or urine from spreading to the passenger spaces must be fitted.

##### ***Under Cover.***

If cattle are carried under cover on the same deck level as passengers they must be separated from the passenger space by a fixed or portable close bulkhead running athwartships and extending from the deck to the covering above, or by other effective means.

##### ***In the 'tween decks or holds***

If cattle are carried either in the 'tween decks or holds, the passenger space must be effectively shut off from the cattle space and separately ventilated.

When ships carry vehicles, cattle or other cargo in any space measured for passengers, the number of passengers for which the space measures should be reduced by one for every nine square feet of space occupied by vehicles, cattle or other cargo or by such greater number as may be necessary to ensure that the provisions of paragraph 428 are complied with.

In no case may motor vehicles be carried in covered spaces measured for passengers, or in sheltered spaces set apart for passengers as indicated in paragraph 428 without prior approval from Headquarters. Spaces set apart exclusively for the carriage of motor vehicles must not be included in the spaces measured for passengers.

#### **434. *Marking and Apportionment of Spaces where Deck Passengers are carried***

If two or more classes of passengers are carried, the whole clear area of deck, with the exception of the promenade or airing space reserved for the passengers accommodated in enclosed spaces, may be apportioned between the classes as desired, and the marking of spaces for passengers carried on deck is to include a statement of the number of passengers allowed for each clear area.

Except as provided in paragraph 435, each deck space is to be permanently marked in a suitable position as follows:—

"The deck from this mark to the .....\* contains  
..... square feet and is certified for .....†  
passengers when not occupied by cargo, stores or other encumbrances.

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\* State the part of the deck to which the measurement in question is taken.

† State the number and class of passengers.



When cargo, stores or other encumbrances are carried in this space, the number of passengers for which the space is certified is to be reduced by one for every nine square feet so occupied".

If deck passengers are not carried, no marking is necessary.

**435. *Marking by only one Notice in certain cases***

If the shipowner so desires, the passenger certificate may show in one total without division into classes the number of passengers for whom there is accommodation, and the spaces on deck for the accommodation of the various classes of passengers need not then be marked as required in paragraph 434. The owner may apportion as he pleases between classes of passengers such of the deck space as may be clear each voyage provided that for each passenger carried on deck, there is nine square feet of space free from vehicles, cattle, or other cargo and that there is sufficient shelter at the rate of six square feet each for the number of passengers actually carried from 1st November to 31st March or the Friday before Good Friday (whichever is the earlier), and at the rate of three square feet each at all other times. The marking of the ship in this case should consist of a clearly legible painted notice, placed in a conspicuous position, in the following terms:—

"This ship is certified to carry . . . . . passengers, at the rate of nine square feet per person of deck space unencumbered by vehicles, cattle or other cargo, provided that sheltered spaces are made available for all passengers at the rate of six square feet per person from 1st November to 31st March or the Friday before Good Friday (whichever is the earlier), and at the rate of three square feet per person at all other times".

As in these cases the number of passengers of each class is not stated separately on the passenger certificate, the number of water closets required for each class should be based upon the greatest numbers of passengers of the respective classes that are likely to be carried, having regard to the structural arrangements for the accommodation of the passengers. The Surveyor should report on Surveys 8A the normal division of passengers into classes. (See also paragraph 428).

### CLASS III SHIPS

**436. *General***

The requirements of paragraphs 413, 414, 415, 422, 423, 426, 430 and 432 apply to Class III ships.

**437. *Number of Passengers***

The instructions for the measurement of spaces and the determination of the number of passengers are the same as those laid down for Class II and Class II(A) ships in paragraphs 424 and 425.

The requirements of paragraphs 427 (Airing Space), 428 (Shelter for Passengers) and 429 (Limitation of total number of passengers by gross tonnage) do not apply to Class III ships.

**438. *Sheathing of Steel or Metal Decks***

The floors and crowns of spaces in which passengers are accommodated must comply with the requirements of paragraph 416, but wood sheathing less than 2½ ins. thick may be allowed on exposed decks forming the crowns of passenger accommodation, subject to approval by the Chief Ship Surveyor. If exposed decks of steel or metal on which passengers are carried are not covered with wood or an approved composition, provision must be made to prevent passengers from slipping.

#### **439. Design and Construction**

Class III ships must be so designed and constructed as to be capable of withstanding any weather they may encounter.

#### **440. Deductions when vehicles, cattle or other cargo are carried**

When vehicles, cattle or other cargo are carried in any space measured for passengers, the number of passengers is to be reduced by one for every nine square feet so occupied.

In no case may motor vehicles be carried in covered spaces measured for passengers without the Ministry's prior approval. Spaces set apart exclusively for the carriage of vehicles are not to be included in the spaces measured for the determination of passenger numbers.

#### **441. Marking of Deck Spaces where Passengers are carried**

Except as provided below, each deck space must be marked with a painted notice so placed as to be legible to the passengers at all times, in the following terms:—

“The deck from this mark to the .....\* contains ..... square feet, and is certified for ..... passengers when not occupied by cargo, stores or other encumbrances.

When cargo, stores or other encumbrances are carried in this space the number of passengers for which the space is certified is to be reduced by one for every nine square feet so occupied”.

If the Surveyor is satisfied that vehicles, cattle or other cargo are not to be carried in a deck space measured for passengers that space need not be marked as indicated above.

### **CLASS IV SHIPS**

#### **442. General**

The requirements of paragraphs 413, 414, 415, 422, 423, 430 and 431 apply to Class IV ships.

#### **443. Number of Passengers**

(1) Subject to the provision of sub-paragraph (2) the instructions for the measurement of passenger spaces are the same as those laid down for Class III ships, except as follows:—

- (a) The number of passengers allowed for the main deck should be determined by dividing the clear area of the deck in square feet by six.
- (b) The number of passengers allowed for the saloon or cabin under the main deck should be determined by dividing the clear area in square feet by nine. Only one saloon below deck should normally be included in the passenger measurements, but two saloons may be included if of moderate size, subject to approval by the Chief Ship Surveyor.
- (c) Where there are seats on skylights or companionway openings, the measurements may be extended to the back of these seats.
- (d) The tops of deck houses should be dealt with in accordance with paragraph 423 and the number of persons allowed for such spaces and for decks above the main deck should be determined by dividing the clear area of the space in square feet by nine.
- (e) Where smoke rooms or saloons are situated on the main deck, the employment of the divisor six may result in a larger number of passengers than can be properly accommodated in such spaces. When the

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\* State the part of the deck to which the measurement in question is taken.

whole space available for passengers is on the main deck and the gross area of such smoke room or saloon is under 90 square feet, the number of passengers should be determined by dividing the clear floor space by nine, but if the gross area is 90 square feet or above, the divisor should be six. This restriction need not be applied to ships which have considerable areas available for passengers on a bridge deck or lower deck, nor to very small ships.

(f) No distinction should be made between classes of passengers.

(g) The requirements of paragraph 426 (Seating) apply to Class IV ships but where owners consider it impracticable or unreasonable to provide seats for all passengers, particulars should be submitted to the Chief Ship Surveyor.

**(2) Winter Numbers**

The number of passengers determined in accordance with the preceding instructions should be reduced by one-third for the period between 31st October and 1st April for all spaces which are not effectively protected from the weather.

**444. Carriage of vehicles, cattle or other cargo in Deck Spaces measured for Passengers.**

- (1) Spaces set apart exclusively for the carriage of vehicles must not be included in the spaces measured for the determination of passenger numbers.
- (2) Motor vehicles must not be carried in covered spaces measured for passengers without the Ministry's prior approval.
- (3) When vehicles, cattle or other cargo are carried in any deck space measured for passengers, the number of passengers is to be reduced by one for every six square feet (or nine square feet in the case of decks above the main deck) so occupied.
- (4) If, in ships making short passages, passengers are allowed to remain in their motor cars or other vehicles, the passenger numbers must still be reduced in the manner indicated in sub-paragraph (3) above if such cars or vehicles occupy space which has been measured for passengers. The number of passengers allowed to remain in the cars or vehicles must not, however, be added to the reduced passenger number.
- (5) The Surveyor should draw the attention of the Owner or his representative to the advantage of having lines marked on decks to delineate prescribed areas, thus facilitating calculation of the passenger numbers appropriate to particular voyages, especially on ships which regularly carry motor cars and other vehicles.
- (6) Where passengers are allowed to remain in their motor cars or other vehicles in ships making short passages, there must be sufficient clearance between the vehicles to allow passengers to escape readily in an emergency. Surveyors should ensure that owners and their representatives are fully aware of this requirement and at every convenient opportunity should visit such ships to see that it is complied with.

**445. Marking of Deck Spaces where Passengers are carried**

Except as provided below each deck space must be marked with a painted notice, so placed as to be legible to the passengers at all times, in the following terms:—

"The deck from this mark to the .....\* contains  
..... square feet, and is certified for .....  
passengers when not occupied by cargo, stores or other encumbrances.

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\* State the part of the deck to which the measurement in question is taken.



When cargo, stores or other encumbrances are carried in this space, the number of passengers for which the space is certified must be reduced by one for every .....† square feet so occupied”.

If the Surveyor is satisfied that vehicles, cattle or other cargo are not to be carried in a deck space measured for passengers, that space need not be marked as indicated above.

#### **446. *Water Closets and Urinals***

In Class IV ships some relaxation from the full requirements of paragraph 432 may be allowed, having regard to the particular service.

### **CLASS V SHIPS**

#### **447. *General***

The requirements of paragraphs 413, 414, 415, 422, 423, 430 and 438 apply to Class V ships.

#### **448. *Plans and Particulars required***

On first survey, particulars and plans showing the construction, materials and scantlings of the hull should be submitted to the Chief Ship Surveyor. The plans should show the extent of the passenger accommodation.

#### **449. *Decked Ships. Number of Passengers***

The number of passengers allowed is to be ascertained in the same way as for Class IV ships, except as follows:—

- (a) The number of passengers allowed for the main deck should be determined by dividing the clear area of the deck in square feet by three. The forward extremity of the space measured for passengers should be determined by the Surveyor, with due regard to the stowage and handling of the anchor and cable and other necessary equipment in the bow of the vessel but the restriction to one-eighth of the vessel's registered length (paragraph 423) need not apply.
- (b) Where smoke rooms or small saloons are situated on the main deck, the use of the divisor three may result in a larger number of passengers than can be properly accommodated in such space. When the whole space available for passengers is on the main deck and the gross area of such smoke room or saloon is under 90 square feet, the clear area should be divided by nine; if the gross area is 90 and under 270 square feet, the divisor should be six; and if the gross area is 270 square feet or over, the divisor should be three. This restriction need not be applied to ships which have considerable areas available for passengers on a bridge deck or lower deck, nor to very small ships and ships exclusively employed as ferry boats.
- (c) The requirements of paragraph 426 (Seating) apply to Class V ships, but may be relaxed for ships making short passages, where there is sufficient space clear of the seats to accommodate standing passengers. Scale plans showing the spaces available for standing passengers should be submitted.
- (d) No reduction in passenger numbers need be made for the period between 31st October and 1st April.

#### **450. *Carriage of Vehicles, Cattle or other cargo in Deck Spaces measured for Passengers***

- (1) Spaces set apart exclusively for the carriage of vehicles must not be

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† Six for the main deck and nine for decks above the main deck.

included in the spaces measured for the determination of passenger numbers.

- (2) Motor vehicles must not be carried in covered spaces measured for passengers without the Ministry's prior approval.
- (3) When vehicles, cattle or other cargo are carried in spaces measured for passengers the number of passengers is to be reduced by one for every three square feet (or nine square feet in the case of decks above the main deck) so occupied.
- (4) If, in ships making short passages, passengers are allowed to remain in their motor cars or other vehicles, passenger numbers must still be reduced in the manner indicated in sub-paragraph (3) above if such cars or vehicles occupy space which has been measured for passengers. The number of passengers allowed to remain in the cars or vehicles must not however be added to the reduced passenger number.
- (5) The Surveyor should draw the attention of the owner or his representative to the advantage of having lines marked on decks to delineate prescribed areas, thus facilitating calculation of the passenger numbers appropriate to particular voyages, especially on ships which regularly carry motor cars and other vehicles.
- (6) Where passengers are allowed to remain in their motor cars or other vehicles in ships making short passages there must be sufficient clearance between the vehicles to allow passengers to escape readily in an emergency. Surveyors should ensure that owners and their representatives are fully aware of this requirement and at every convenient opportunity should visit such ships to see that it is complied with.

#### 451. *Marking of Deck Spaces where Passengers are carried*

Except as provided below, each deck space must be marked with a painted notice, so placed as to be legible to the passengers at all times, in the following terms:—

"The deck from this mark to the .....\* contains ..... square feet, and is certified for ..... passengers when not occupied by cargo, stores or other encumbrances.

When cargo, stores or other encumbrances are carried in this space, the number of passengers for which the space is certified must be reduced by one for every .....† square feet so occupied".

If the Surveyor is satisfied that vehicles, cattle or other cargo are not to be carried in a deck space measured for passengers, that space need not be marked as indicated above.

#### 452. *Open Launches. Number of Passengers*

The forward extremity of the space available for the passenger accommodation is to be determined by the Surveyor, with due regard to the proper stowage of the anchor and cable and to any other necessary equipment in the bow of the vessel, and the length should be measured from this point to the foreside of the bulkhead separating the motor space from the passenger space. If the motor is placed amidships (see paragraph 375) an additional space may be available for passengers between the after bulkhead of the motor space and a position near the stern of the vessel to be determined by the Surveyor as suitable, having due regard to the steering arrangements and fuel tank space.

The breadths should be measured at suitable intervals to the back of the side benches or to the inside of the gunwale or to the inside of the half deck (where fitted) whichever measurement is least.

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\* State the part of the deck to which the measurement in question is taken.

† Three for the main deck and nine for decks above the main deck.

The spaces abreast of the motor may be included in the passenger measurements if the motor is enclosed by a casing or longitudinal bulkheads constructed in accordance with paragraph 375 and if the distance between the sides of the casing or bulkheads and the back of the seats is at least three feet.

The number of passengers allowable by area is found by dividing by three the area in square feet of the clear space measured as above. Allowance should be made for the crew in the area measurements. The number allowable by seating is found by dividing the length in feet of each continuous fixed seat by 1.5 the measurements being taken along the inner edges of the seats. Where buoyant apparatus is used for seating the capacity of each unit is to be computed separately.

The number allowable for each part is the lesser of the numbers given by area and by seating except in the case of short passages where it is clear that the full number as determined by area can safely be carried.

#### **453. *Vessels with Cockpits and Shelters. Number of Passengers***

Vessels which have cockpits with shelters fitted over them should first be measured as if no shelters were provided. The clear area of the top of one shelter may then be measured for passengers at the rate of one passenger for every nine square feet, provided the Surveyor is satisfied that the structure is strong enough, the sides are properly protected and the vessel is sufficiently stable to carry all the passengers who can gain access to the top of the shelter. The top of only one shelter may be measured unless permission to measure more than one is given by the Chief Ship Surveyor.

Fully, or partly decked vessels having the central portion of the main deck raised considerably above the gunwale should be measured under this paragraph as though having open cockpits. Where, however, owing to the design of the vessel, the Surveyor is of the opinion that any departure from this method of measurement is desirable, full particulars should be submitted for consideration.

#### **454. *Seating Arrangements***

In all vessels the seating must be so arranged that there will be no serious obstacle to prevent a person from passing forward and aft quickly in case of emergency.

#### **455. *Water Closets and Urinals***

Some relaxation may be allowed from the full requirements of paragraph 432 having regard to the particular service.

#### **456. *Stability***

Unless particulars of the position of the transverse metacentre at various draughts are available, the inclining experiment to which paragraphs 120 and 430 refer should be carried out with the vessel loaded with weights to represent the fully laden condition.

In open boats the centre of gravity of the passengers should be taken at 1 foot above the seat.

#### **457. *Position of Helmsman***

The Surveyor should ensure that, whatever the design of the vessel, the helmsman will at all times have a clear view for safe navigation.

#### **458. *Awnings***

In view of the importance of ensuring immediate escape of passengers and the ready availability of buoyant apparatus in the event of collision or other



emergency, awnings should not normally be fitted. When, however, an owner specially desires to fit an awning over part of the length of the vessel full particulars should be submitted to the Chief Ship Surveyor.

#### **459. *Flooring***

Flooring must be provided throughout the vessel. It must be removable to allow for cleaning and inspection, and must allow rapid drainage of water to the bilges particularly in open launches. Drain plugs in the skin of the vessel will not be permitted.

#### **460. *Structural Fire Protection***

In all vessels fitted with internal combustion engines or oil fired boilers, the bulkheads separating the machinery space from the accommodation spaces should normally be made of steel and insulated so as to provide an effective fire division (see also paragraph 168). In open wooden boats, however, these bulkheads may be of wood provided they are constructed and lined as required in paragraph 375.

### **CLASS VI SHIPS**

See Circular 1704 (H.M.S.O. 1954, Price 6d. net), reprinted as Appendix VI

# APPENDIX I

## Merchant Shipping

### Safety

## The Merchant Shipping (Construction) Rules, 1952

<i>Made</i>	11th November, 1952
<i>Laid before Parliament</i>	13th November, 1952
<i>Coming into Operation</i>	19th November, 1952

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The Minister of Transport in exercise of the powers conferred upon him by section 1 of the Merchant Shipping (Safety Convention) Act, 1949(a), and of all other powers him enabling in that behalf hereby makes the following Rules:

## PART I

### GENERAL

#### *Interpretation*

1. (1) These Rules shall come into operation on the nineteenth day of November, 1952, and may be cited as the Merchant Shipping (Construction) Rules, 1952.

(2) In these Rules, unless the context otherwise requires, the following expressions have the meanings hereby respectively assigned to them:

“ ‘A’ Class division ” means a bulkhead or part of a deck, in either case complying with such of the requirements of Rule 44 of these Rules as are expressed to apply to “A” Class divisions.

“Accommodation space” includes :

- (a) passenger spaces,
- (b) crew space,
- (c) offices,
- (d) pantries, and
- (e) space similar to any of the foregoing,

not being service spaces or open spaces on deck.

“ ‘B’ Class division ” means a bulkhead complying with such of the requirements of Rule 44 of these Rules as are expressed to apply to “B” Class divisions.

“Breadth of the ship” means the greatest moulded breadth at or below the ship’s deepest subdivision load water line.

“Bulkhead deck” means the uppermost deck up to which transverse watertight bulkheads are carried.

“Cargo space” in Part V of these Rules means space appropriated for cargo, other than mail and bullion, and trunks leading to such spaces.

“Control station” includes:

- (a) a radiotelegraph room;
- (b) any other enclosed space which houses
  - (i) a compass, direction-finder, radar equipment, a steering wheel, or other similar equipment used in navigation;
  - (ii) a central indicator connected with a system for the detection of fire or smoke; or
  - (iii) an emergency generator.

“Crew space” means crew accommodation within the meaning of the Merchant Shipping Act, 1948(b).

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(a) 12, 13 & 14 Geo. 6 c. 43.

(b) 11 & 12 Geo. 6. c. 44.

"Criterion numeral" in relation to any ship means the criterion numeral of the ship determined in accordance with such of the provisions of the Second Schedule to these Rules as apply to that ship.

"Draught" means the vertical distance from the moulded base line amidships to a subdivision load water line.

"Factor of subdivision" in relation to any ship or portion thereof means the factor of subdivision determined in accordance with such of the provisions of the Second Schedule to these Rules as apply to that ship or portion as the case may be.

"Floodable length" in relation to any portion of a ship at any draught means the maximum length of that portion having its centre at a given point in the ship which, at that draught and under such of the assumptions of permeability set forth in the Second Schedule to these Rules as are applicable in the circumstances, can be flooded without submerging any part of the ship's margin line when the ship has no list.

"Incombustible material" means material which when heated to a temperature of 1382°F. (750°C.) neither burns nor gives off inflammable vapours in sufficient quantity to ignite at a pilot-flame, and the expression "combustible material" shall be construed accordingly.

"Independent power pump" means a pump operated by power otherwise than from the ship's main engines.

"Length" in relation to a ship means the length of a ship measured between perpendiculars taken at the extremities of the deepest subdivision load water line.

"Machinery space" in every Part of these Rules, other than Parts V and V(A), means space extending from the moulded baseline of the ship to the margin line and between the extreme transverse watertight bulkheads bounding the spaces appropriated to the main and auxiliary propelling machinery, boilers, if any, and the permanent coal bunkers, if any.

"Machinery space" in Parts V and V(A) of these Rules includes space in which propelling or refrigerating machinery, boilers, pumps, engineers' workshops, generators, ventilation or air conditioning machinery, or oil filling stations are situated, and trunkways leading to such spaces.

"Main circulating pump" means the pump installed for circulating water through the main condenser.

"Main vertical zones" means the main vertical zones into which the hull, superstructure and deckhouses of a ship are divided in accordance with paragraph (2) of Rule 45 of these Rules.

"Margin line" means a line drawn at least 3 inches below the upper surface of the bulkhead deck at the side of a ship, and assumed for the purpose of determining the floodable length of the ship.

"Minister" means the Minister of Transport.

"Mile" means a nautical mile of 6080 feet.

"Passenger space" means space provided for the use of passengers.

"Permeability" in relation to a space means the percentage of that space below the ship's margin line which, on the assumption that it is in use for the purpose for which it is appropriated, can be occupied by water.

"Public Room" includes halls, dining rooms, bars, smoke rooms, lounges, recreation rooms, nurseries and libraries.

"Radiotelegraph room" has the same meaning as in the Merchant Shipping (Radio) Rules, 1952(c).

"Service space" includes galleys, main pantries, laundries, store rooms, paint rooms, baggage rooms, mail rooms, bullion rooms, carpenters' and plumbers' workshops, and trunkways leading to such spaces.

“Standard fire test” means a test which develops in a test furnace a series of time-temperature relationships as follows:

At the end of the first 5 minutes	1000°F. (538°C.)
At the end of the first 10 minutes	1300°F. (704°C.)
At the end of the first 30 minutes	1550°F. (843°C.)
At the end of the first 60 minutes	1700°F. (927°C.)

“Steamer” includes a ship propelled by electricity or other mechanical power.

“Subdivision load line” has the same meaning as in Section 23 of the Merchant Shipping (Safety and Load Line Conventions) Act, 1932(d).

“Subdivision load water line” means the water line assumed in determining the subdivision of the ship in accordance with these Rules.

“Watertight” in relation to a structure means capable of preventing the passage of water through the structure in any direction under a head of water up to the ship’s margin line.

“Weathertight” in relation to a structure means capable of preventing the passage of sea water through the structure in ordinary sea conditions.

(3) These Rules apply to British passenger steamers registered in the United Kingdom. Provided that the Minister may exempt any ship the keel of which was laid before the date on which these Rules come into operation, not being a ship converted on or after that date for service as a passenger steamer, from the requirements of these Rules to the extent that he is satisfied that compliance therewith is unreasonable or impracticable in the circumstances.

(4) The Interpretation Act, 1889(e), shall apply to the interpretation of these Rules as it applies to the interpretation of an Act of Parliament.

#### *Classification of Ships*

2. (1) For the purposes of these Rules British passenger steamers registered in the United Kingdom shall be arranged in Classes as follows:

##### *Ships engaged on International Voyages*

Class I. Ships engaged on voyages any of which are long international voyages.

Class II. Ships engaged on voyages (not being long international voyages) any of which are short international voyages.

##### *Ships not engaged on International Voyages*

Class II(A). Ships engaged on voyages of any kind other than international voyages.

Class III. Ships engaged only on voyages in the course of which they are at no time more than 70 miles by sea from their point of departure and not more than 18 miles from the coast of the United Kingdom, and which are at sea only in fine weather and during restricted periods.

Class IV. Ships engaged only on voyages of the following descriptions:

(a) voyages in partially smooth waters;

(b) voyages in smooth waters.

Class V. Ships engaged only on voyages in smooth waters.

Class VI. Ships engaged only on voyages of the following descriptions:

(a) voyages with not more than 250 passengers on board, to sea or in partially smooth waters, in either case in fine weather and during restricted periods, in the course of which the ships are at no time more than 15 miles, exclusive of any smooth waters, from their point of departure nor more than 3 miles from land;

(b) voyages in smooth waters.

Class VI(A). Ships carrying not more than 50 passengers for a distance of not more than 6 miles on voyages to or from isolated communities on the islands or coast of Scotland, and which do not proceed for a distance of more than 3 miles from land.

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(d) 22 Geo. 5. c. 9.

(e) 52 & 53 Vict. c. 63.



(2) For the purposes of this Rule the following expressions have the meanings hereby respectively assigned to them, that is to say:

"Long international voyage" means an international voyage which is not a short international voyage within the meaning of the Merchant Shipping (Safety Convention) Act, 1949.

"Partially smooth waters" means, as respects any period specified in the First Schedule to these Rules, the waters of any of the areas specified in the third column of that Schedule in relation to that period.

"Restricted period" means a period falling wholly within the following limits:

(a) from 1st April to 31st October, both dates inclusive; and

(b) between one hour before sunrise and one hour after sunset in the case of ships fitted with navigation lights conforming to the collision regulations, and between sunrise and sunset in the case of any other ships.

"Sea" does not include any partially smooth waters.

"Smooth waters" means any waters not being the sea or partially smooth waters, and in particular means waters of any of the areas specified in the second column of the First Schedule to these Rules.

"Voyage" includes an excursion.

### *Structural Strength*

3. The structural strength of every ship to which these Rules apply shall be sufficient for the service for which the ship is intended.

## **PART II**

### **WATERTIGHT SUBDIVISION**

#### *Application of Part II*

4. This Part of these Rules applies to every ship to which these Rules apply, not being an open or partially decked ship of Class V or a ship of Class VI carrying less than 151 passengers or a ship of Class VI(A).

#### *Watertight Subdivision*

5. Every ship to which this Part of these Rules applies shall be subdivided by bulkheads, which shall be watertight up to the bulkhead deck, into compartments the maximum length of which shall be calculated in accordance with such of the provisions of the Second Schedule to these Rules as apply to that ship. Every other portion of the internal structure which affects the efficiency of the subdivision of the ship shall be watertight, and shall be of a design which will maintain the integrity of the subdivision.

#### *Peak and Machinery Space Bulkheads, Shaft Tunnels, etc.*

6. (1) Every ship to which this Part of these Rules applies shall be provided with a collision bulkhead which shall be watertight up to the bulkhead deck and shall be fitted at a distance from the ship's forward perpendicular of not less than 5 per cent. of the length of the ship and not more than 10 feet plus 5 per cent. of such length. If the ship has a forward superstructure, the collision bulkhead shall be extended weather-tight to the deck next above the bulkhead deck. The extension shall be fitted directly over the collision bulkhead below unless it is at least 5 per cent. of the length of the ship from the forward perpendicular and the part of the bulkhead deck which forms the step is made weathertight. The plating and stiffeners of such extension shall be constructed in accordance with the provisions of the Fourth Schedule to these Rules as if the extension formed part of a bulkhead immediately below the bulkhead deck.

(2) Every such ship shall be provided with a watertight afterpeak bulkhead and with watertight bulkheads dividing the space appropriated to the main and auxiliary propelling machinery, boilers, if any, and the permanent coal bunkers, if any, from other spaces. Such bulkheads shall be watertight up to the bulkhead deck. Provided that the afterpeak bulkhead may be stopped below the bulkhead deck if the safety of the ship is not thereby impaired.

(3) The stern gland of every such ship shall be situated in a watertight shaft tunnel or other watertight space separate from the stern tube compartment and of such a volume that if the tunnel or space is flooded the margin line will not be submerged. The stern tube shall be enclosed in a watertight compartment, the volume of which shall be the smallest compatible with the proper design of the ship.

#### *Double Bottoms*

7. (1) Subject to the provisions of this Rule every ship of Classes I, II and II(A) shall be fitted with a watertight double bottom which shall be at least of the following extent:

- (a) in ships of 200 feet but less than 249 feet in length: from the machinery space to the collision bulkhead or as near to that bulkhead as is practicable;
- (b) in ships of 249 feet but less than 330 feet in length: from the collision bulkhead to the afterpeak bulkhead or as near to those bulkheads as is practicable, but not necessarily in the machinery space;
- (c) in ships of 330 feet in length and upwards: from the collision bulkhead to the afterpeak bulkhead or as near to those bulkheads as is practicable.

(2) When a double bottom is required by this Rule to be fitted in a ship, the inner bottom shall be continued out to the ship's sides in such a manner as to protect the bottom to the turn of the bilge. The inner bottom shall be deemed to be adequate for this purpose if the line of intersection of the outer edge of the margin plate with the bilge plating is not lower at any point than a horizontal plane passing through the point of intersection with the frame line amidships of a transverse diagonal line inclined at 25 degrees to the base line and cutting it at a point one-half of the ship's moulded breadth from the middle line.

(3) Wells constructed in the double bottom for the purpose of drainage shall not be larger or extend downwards more than is necessary for such purpose, and shall not be less than 18 inches from the outer bottom or from the inner edge of the margin plate. Provided that a well extending to the outer bottom may be constructed at the after end of a shaft tunnel.

(4) Wells for purposes other than drainage shall not be constructed in the double bottom. The Minister may exempt any ship from the requirements of this paragraph in respect of any well which he is satisfied will not diminish the protection given by the double bottom.

(5) Nothing in this Rule shall require a double bottom to be fitted in way of watertight compartments used exclusively for the carriage of liquids, if the safety of the ship will not be impaired in the event of bottom or side damage by reason of the absence of a double bottom in that position.

(6) The Minister may exempt any ship of Class II or II(A) from the requirements of a double bottom in any portion of the ship which is subdivided by application of a factor of subdivision not exceeding .5, if he is satisfied that the fitting of a double bottom in that portion of the ship would not be compatible with the design and proper working of the ship.

#### *Stability in Damaged Condition*

8. (1) Every ship to which this Part of these Rules applies shall be so constructed as to provide sufficient intact stability in all service conditions to enable the ship to withstand the final flooding of any one of the main compartments into which the ship is subdivided in accordance with the provisions of Rule 5 of these Rules. If two of the main compartments, being adjacent to each other, are separated by a bulkhead which is stepped, the intact stability shall be adequate to withstand the final flooding of those compartments. If the ship's factor of subdivision is .5 or less, the intact stability shall be adequate to withstand the final flooding of any two of the main compartments which are adjacent to each other.

(2) For the purposes of this Rule the sufficiency of the intact stability of every such ship shall be determined in accordance with the provisions of the Third Schedule to these Rules.

(3) (a) Every ship to which this Part of these Rules applies shall be so constructed as to keep unsymmetrical flooding when the ship is in a damaged condition at the minimum consistent with efficient arrangements. If cross-flooding fittings are provided in any such ship the fittings and the maximum heel of the ship before equalisation shall be such as will not endanger the safety of the ship.

(b) If the margin line may become submerged during the flooding assumed for the purposes of the calculation referred to in the Third Schedule to these Rules, the construction of the ship shall be such as will enable the master of the ship to ensure

(i) that the maximum angle of heel during any stage of such flooding will not be such as will endanger the safety of the ship; and

(ii) that the margin line will not be submerged in the final stage of flooding.

(4) (a) There shall be provided in every such ship a document for the use of the master of the ship containing information as to the use of any cross-flooding fittings provided in the ship.

(b) There shall be provided in every ship of Classes I, II and II(A) a document for the use of the master of the ship containing the following additional information:

(i) information necessary for the maintenance of sufficient intact stability under service conditions to enable the ship to withstand damage to the extent referred to in the Third Schedule to these Rules; and

(ii) information as to the conditions of stability on which the calculations of heel have been based, together with the information that excessive heeling might result should the ship sustain damage when in a less favourable condition

#### *Construction of Watertight Bulkheads, etc.*

9. (1) In every ship to which this Part of these Rules applies every portion of the ship required by these Rules to be watertight shall be constructed in accordance with such of the requirements of the Fourth Schedule to these Rules as apply to it.

(2) In every such ship all tanks forming part of the structure of the ship and used for the storage of oil fuel or other liquids including double bottoms, peak tanks, settling tanks and bunkers, shall be of a design and construction adequate for that purpose.

#### *Openings in Watertight Bulkheads, etc.*

10. (1) In every ship of Classes I, II and II(A) the number of openings in bulkheads and other structures required by these Rules to be watertight shall be the minimum compatible with the design and proper working of the ship.

(2) So far as practicable, trunks installed in connection with ventilation, forced draught or refrigeration systems in any such ship shall not pierce such bulkheads or structures.

(3) Every tunnel above the double bottom, if any, in such a ship whether for access from the crew space to the machinery space, for piping or for any other purpose, which passes through such a bulkhead shall be watertight. The means of access to at least one end of such tunnel, if it may be used as a passage at sea, shall be through a trunkway extending watertight to a height sufficient to permit access above the margin line. The means of access to the other end of the tunnel shall be through a watertight door. No tunnel shall extend through the first subdivision bulkhead abaft the collision bulkhead.

(4) Not more than one doorway (other than a bunker or tunnel doorway) shall pierce such a bulkhead in the machinery space in any such ship. If any such bulkhead is pierced by a doorway the doorway shall be placed so as to have the sill as high as possible in the ship.

(5) Doorways, manholes and access openings shall not be fitted in the collision bulkhead below the margin line of any such ship or in any other bulkhead which is required by these Rules to be watertight and which divides a cargo space from another cargo space or from a permanent or reserve bunker. Provided that the Minister may permit any such ship to be fitted with doorways in bulkheads dividing two between deck cargo spaces if he is satisfied that:

(i) the doorways are necessary for the proper working of the ship;



- (ii) the number of such doorways in the ship is the minimum compatible with the design and proper working of the ship, and they are fitted at the highest practicable level; and
- (iii) the outboard vertical edges of such doorways are situated at a distance from the ship's shell plating which is not less than one-fifth of the breadth of the ship, such distance being measured at right angles to the centre line of the ship at the level of the deepest subdivision load water line.

(6) In every ship of Classes I, II and II(A) bulkheads outside the machinery space which are required by these Rules to be watertight shall not be pierced by openings which are capable of being closed only by portable bolted plates.

(7) In every ship of Classes III to VI, inclusive, to which this Part of these Rules applies, bulkheads required by these Rules to be watertight shall not be pierced by doorways, ventilation trunks, or other similar openings.

(8) In every ship to which this Part of these Rules applies:

- (a) (i) valves and cocks not forming part of a pipe system shall not be fitted in any bulkhead required by these Rules to be watertight;
- (ii) if any such bulkhead is pierced by pipes, scuppers, electric cables or other similar fittings, provision shall be made which will ensure that the watertightness of the bulkhead is not thereby impaired.
- (b) The collision bulkhead of such a ship shall not be pierced below the margin line by more than one pipe. Provided that if the forepeak in such a ship is divided to hold two different kinds of liquids the collision bulkhead may be pierced below the margin line by not more than two pipes. Any pipe which pierces the collision bulkhead of such a ship shall be fitted with a screw-down valve capable of being operated from above the bulkhead deck, the valve chest being secured to the forward side of the collision bulkhead.

#### *Means of Closing Openings in Watertight Bulkheads, etc.*

11. (1) In every ship of Classes I, II and II(A) efficient means shall be provided for closing and making watertight all openings in bulkheads and other structures required by these Rules to be watertight.

(2) Every door fitted to any such opening shall be a sliding watertight door. Provided that, in a ship of Class I, or in any ship of Class II or II(A) which is not required by paragraph 9 of the Second Schedule to these Rules to have a factor of subdivision of .5 or less, hinged watertight doors may be fitted:

- (a) in passenger, crew and working spaces above any deck the underside of which at its lowest point is at least 7 feet above the deepest subdivision load water line; and
- (b) in any such bulkhead, not being a collision bulkhead, which divides two cargo between deck spaces.

(3) Every such hinged watertight door shall be fitted with catches capable of being worked from each side of the bulkhead in which the door is fitted.

(4) All doors required by these Rules to be watertight shall be secured by means other than bolts, and shall be closed by means other than gravity or a dropping weight.

(5) In every ship of Classes I, II and II(A) watertight doors fitted in bulkheads between permanent and reserve bunkers, other than the doors referred to in paragraph (3) of Rule 12 of these Rules, shall always be accessible.

#### *Means of Operating Sliding Watertight Doors*

12. (1) If, in any ship of Class I, or a ship of Class II or Class II(A) not required by paragraph 9 of the Second Schedule to these Rules to have a factor of subdivision of .5 or less, any sliding watertight door fitted in a bulkhead (other than a door at the entrance to a tunnel) is in a position which may require it to be opened at sea and the sill thereof is below the deepest subdivision load water line, the following requirements shall apply:

- (a) If the number of such doors exceeds five, all such doors and all tunnel doors shall be operated by power and shall be capable of being simultaneously closed from a central control situated on the bridge;

(b) If the number of such doors does not exceed five:

- (i) if the criterion numeral of the ship does not exceed 30, such doors and tunnel doors shall not be required to be operated by power;
- (ii) if the criterion numeral of the ship exceeds 30, all such doors and all tunnel doors shall be operated by power and shall be capable of being simultaneously closed from a central control situated on the bridge. Provided that, if there is only one such door and one tunnel door in the ship, both of which are in the machinery space, they shall not be required to be operated by power.

(2) In every ship of Class II or II(A) required by paragraph 9 of the Second Schedule to these Rules to have a factor of subdivision not exceeding .5, all sliding watertight doors shall be operated by power and shall be capable of being simultaneously closed from a central control situated on the bridge. Provided that, if in any such ship there is only one such door and it is in the machinery space, it shall not be required to be operated by power.

(3) If, in any ship of Class I, II or II(A) any sliding watertight doors which may be opened at sea for the purpose of trimming coal are fitted between bunkers in the between decks below the bulkhead deck, such doors shall be operated by power.

(4) If, in any ship of Class I, II or II(A) a trunkway, being part of a refrigeration, ventilation or forced draught system, is carried through more than one transverse watertight bulkhead and the sills of the openings of such trunkways are less than 7 feet above the deepest subdivision load water line, the sliding watertight doors at such openings shall be operated by power.

(5) If a sliding watertight door is required by these Rules to be operated by power from a central control, the power system shall be so arranged that the door can also be operated by power at the door itself. The arrangement shall be such that the door will close automatically if opened at the door itself after being closed from the central control, and will be capable of being kept closed at the door itself notwithstanding that an attempt may be made to open it from the central control. Handles for controlling the power system shall be provided at both sides of the bulkhead in which the door is situated and shall be so arranged that any person passing through the doorway is able to hold both handles in the open position simultaneously.

(6) In every ship of Classes I, II and II(A) there shall be at least two sources of power for opening and closing all sliding watertight doors which are required by these Rules to be operated by power, and each power unit shall be sufficient to operate simultaneously all such doors in the ship. An indicator shall be fitted at the central control to show whether sufficient power is available for such purposes. Any fluid used for the purpose of operating such doors shall be incapable of freezing at the temperatures likely to be encountered on the voyages on which the ship is engaged.

(7) In every such ship every sliding watertight door which is operated by power shall be provided with efficient hand-operating gear which can be operated both at the door itself and at an accessible position above the bulkhead deck. At the position above the bulkhead deck the hand-operating gear shall be operated with an all-round crank motion.

(8) In every such ship if a sliding watertight door is not required to be operated by power, it shall be provided with efficient hand-operating gear with an all-round crank motion, both at the door itself and at an accessible position above the bulkhead deck.

(9) In every such ship the hand-operating gear for operating the sliding watertight door in the machinery space from above the bulkhead deck shall be placed outside the machinery space unless such a position is inconsistent with the efficient arrangement of the necessary gearing.

#### *Watertight Doors: Signals and Communications*

13. (1) Every sliding watertight door fitted in a ship of Class I, II or II(A) shall be connected with an indicator at each position from which the door may be closed, other than at the door itself, showing whether the door is open or closed.

(2) There shall be provided in connection with every such door which is operated by power a means of giving an audible warning at the door itself when the door is about to be closed. The arrangement shall be such that one movement at the position from which the door is about to be closed will be sufficient to sound the signal and to close the door, the signal preceding the movement of the door by an interval sufficient to allow the movement of persons and articles away from the door.

(3) If any door required by these Rules to be watertight is not capable of being operated from a central control, means of communication by telegraph, telephone or otherwise shall be provided whereby the officer of the watch may communicate with the person responsible for the closing of the door.

#### *Construction of Watertight Doors*

14. (1) Every door required by these Rules to be watertight shall be of such design, material and construction as will maintain the integrity of the watertight bulkhead in which it is fitted.

Any such door giving direct access to any space which may contain bunker coal shall, together with its frame, be made of cast or mild steel. Any such door in any other position shall, together with its frame, be made of cast or mild steel or cast iron.

(2) Every sliding watertight door shall be fitted with rubbing faces of brass or similar material which may be fitted either on the door itself or on the door frame, and which, if they are of less than one inch in width, shall be fitted in recesses.

(3) If screw gear is used for operating such a door, the screw shall work in a nut of suitable non-corrodible metal.

(4) The frame of every vertically sliding watertight door shall have no groove at the bottom thereof in which dirt may lodge. The bottom of such a frame, if it is of skeleton form, shall be so arranged that dirt cannot lodge therein. The bottom edge of every such door shall be tapered or bevelled.

(5) Every vertically sliding watertight door which is operated by power shall be so designed and fitted that, if the power supply ceases, there shall be no danger of the door dropping.

(6) Every horizontally sliding watertight door shall be so installed as to prevent its moving if the ship rolls, and if necessary a clip or other suitable device shall be provided for that purpose. The device shall not interfere with the closing of the door when the door is required to be closed.

(7) The frame of every watertight door shall be properly fitted to the bulkhead in which the door is situated, and the jointing material between the frame and the bulkhead shall be of a type which will not deteriorate or be injured by heat.

(8) Every watertight door, being a coal-bunker door, shall be provided with screens or other devices to prevent coal from interfering with its closing.

#### *Openings in the Shell Plating below the Margin Line*

15. (1) In every ship to which this Part of these Rules applies, the number of side scuttles, scuppers, sanitary discharges and other openings in the shell plating below the margin line shall be the minimum compatible with the design and proper working of the ship.

(2) The arrangements for closing each such opening below the margin line shall be consistent with its intended purpose and shall be such as will ensure watertightness.

(3) (a) In every ship of Classes I, II and II(A) the number of side scuttles below the margin line which are capable of being opened shall be the minimum compatible with the requirements of the proper operation of the ship.

(b) If in a between decks of such a ship the sills of any side scuttles are below a line drawn parallel to the bulkhead deck at side and having its lowest point two and one-half per cent. of the breadth of the ship above the deepest subdivision load water line, every side scuttle in that between decks shall be of a non-opening type. If in a between decks of such a ship all the sills of the side scuttles are above the aforesaid line, every side scuttle in that between decks shall be either of a non-opening type or incapable of being opened except by a person authorised to do so by the master of the ship.



(4) In every ship of Classes III to VI, inclusive, to which this Part of these Rules applies all side scuttles below the margin line shall be of a non-opening type.

(5) In every ship to which this Part of these Rules applies, every side scuttle below the margin line shall be fitted with an efficient hinged deadlight permanently attached so that it can be readily and effectively closed and secured watertight. Provided that abaft a point one-eighth of the length of the ship from the forward perpendicular and above a line drawn parallel to the bulkhead deck at side and having its lowest point at a height of 12 feet plus two and one-half per cent. of the breadth of the ship above the ship's deepest subdivision load water line, deadlights may for the purposes of these Rules be portable in crew spaces and in passenger spaces not appropriated for the use of steerage passengers within the meaning of Part III of the principal Act.

(6) Side scuttles shall not be fitted below the margin line in any space in a ship to which this Part of these Rules applies which is appropriated solely to the carriage of cargo or coal. If side scuttles are fitted in spaces below the margin line which may be appropriated to the carriage either of cargo or of passengers such side scuttles and their deadlights shall be so constructed as to be incapable of being opened except by a person authorised to do so by the master of the ship.

(7) Automatic ventilating side scuttles shall not be fitted below the margin line in the shell plating of any such ship.

(8) (a) In every ship to which this Part of these Rules applies each inlet and discharge led through the shell plating below the margin line shall be fitted with efficient and readily accessible means for preventing the accidental admission of water into the ship.

(b) Without prejudice to the generality of the foregoing, each discharge led through the shell plating from spaces below the margin line, not being a discharge in connection with machinery, shall be provided with either:

(i) one automatic non-return valve fitted with a positive means by which it can be closed from a readily accessible position above the ship's bulkhead deck and with an indicator at the position from which the valve may be closed to show whether the valve is open or closed; or

(ii) two automatic non-return valves, the upper of which is so situated above the ship's deepest subdivision load water line as to be always accessible for examination under service conditions and is of a horizontal balanced type which is normally closed.

(c) Any valve fitted in compliance with the requirements of sub-paragraph (b) which is a geared valve, or the lower of two non-geared valves, shall be secured to the ship's shell plating.

(d) All cocks and valves attached to inlets or discharges, other than inlets or discharges connected with machinery, being cocks or valves fitted below the margin line or the failure of which may affect the subdivision of the ship, shall be made of steel, bronze, or other equally efficient material.

(e) Main and auxiliary inlets and discharges connected with machinery shall be fitted with readily accessible cocks or valves between the pipes and the ship's shell plating or between the pipes and a fabricated box attached to the shell plating. Such cocks or valves of more than 3 inches bore attached to such inlets or discharges shall be made of steel, bronze, or other equally efficient material. If made of steel such cocks and valves shall be protected against corrosion.

(f) Discharge pipes led through the shell plating below the margin line of any ship of Classes I to III, inclusive, shall not be fitted in a direct line between the outboard opening and the connection with the deck, water closet or other similar fitting, but shall be arranged with bends or elbows of substantial metal other than cast iron or lead.

(g) All discharge pipes led through the shell plating below the margin line in such a ship and the valves relating thereto shall be protected from damage.

(h) All bolts connecting cocks, valves, discharge pipes and other similar equipment to the shell plating of such a ship below the margin line shall have their heads outside the shell plating, and shall be either countersunk or cup-headed.

(i) Efficient means shall be provided for the drainage of all watertight decks below the margin line in such a ship and any drainage pipes shall be so fitted with valves or otherwise arranged as to avoid the danger of water passing from a damaged to an undamaged compartment.

(j) The inboard opening of every ash-shoot, rubbish-shoot and other similar shoot in such a ship shall be fitted with an efficient watertight cover, and, if such opening is below the margin line, it shall also be fitted with an automatic non-return valve in the shoot in a readily accessible position above the ship's deepest subdivision load water line. The valve shall be of the horizontal balanced type, normally closed and provided with local means for securing it in a closed position. The requirements of this paragraph shall not apply to ash ejectors and expellers the inboard openings of which are in the ship's stokehold and necessarily below the deepest subdivision load water line. Such ejectors and expellers shall be fitted with means which will prevent water entering the ship.

(k) Any gangway port, cargo port, or coaling port fitted below the margin line of such a ship shall be of adequate strength and its lowest point shall not be below the ship's deepest subdivision load water line.

(9) The Minister may exempt any ship of Classes IV to VI, inclusive, from the requirements of paragraph (8) of this Rule to the extent that he is satisfied that compliance therewith is unreasonable or impracticable in the circumstances.

#### *Side and Other Openings above the Margin Line*

16. In every ship to which this Part of these Rules applies side scuttles, gangway ports, cargo ports, coaling ports, and other openings in the shell plating above the margin line and their means of closing shall be of efficient design and construction and of sufficient strength having regard to the spaces in which they are fitted and their positions relative to the deepest subdivision load water line, and to the intended service of the ship.

#### *Weather Deck*

17. In every ship to which this Part of these Rules applies the bulkhead deck or a deck above the bulkhead deck shall be weathertight. All openings in a weathertight deck shall have coamings of adequate height and strength and shall be provided with efficient and rapid means of closing so as to make them weathertight. Freeing ports or scuppers shall be provided for clearing such deck of water under all weather conditions.

#### *Subdivision Load Lines*

18. (1) Every ship to which this Part of these Rules applies shall be marked on its sides amidships with the subdivision load lines assigned to it by the Minister. The marks shall consist of horizontal lines one inch in breadth, and nine inches in length in the case of a ship which is a load line ship for the purposes of the Merchant Shipping (Safety and Load Line Conventions) Act, 1932, and twelve inches in length in the case of any other ship. The marks shall be painted in white or yellow on a dark ground or in black on a light ground, and shall also be cut in or centre-punched on iron or steel ships, and cut into the planking on wood ships.

(2) The subdivision load lines shall be identified with the letter C, and, in the case of ships of Classes I and II, with consecutive numbers beginning from the deepest subdivision load line which shall be marked C<sub>1</sub>. In the case of ships of Classes I(A) to VI, inclusive:

(a) if there is only one subdivision load line it shall be identified with the letter C;

(b) if there is more than one subdivision load line the subdivision load lines shall be identified with the letter C and with consecutive letters beginning from the deepest subdivision load line, which shall be marked C<sub>A</sub>.

The identifying letters and numerals, shall in every case be painted and cut or centre-punched, as the case may be, on the sides of the ship in the same manner as the lines to which they relate.

## PART II(A)

### SHIPS NOT REQUIRED TO COMPLY WITH PART II

#### *Application of Part II(A)*

19. This Part of these Rules applies to every open or partially decked ship of Class V, and to every ship of Class VI carrying less than 151 passengers, and to every ship of Class VI(A).

#### *Openings in the Sides of the Ship*

20. (1) Efficient means shall be provided for preventing the accidental admission of water into any ship to which this Part of these Rules applies through any openings in the sides of the ship.

(2) Every side scuttle fitted in such a ship shall be of the non-opening type and shall be watertight and of sufficient strength having regard to its position in the ship.

## PART III

### BILGE PUMPING ARRANGEMENTS

#### *Application of Part III*

21. This Part of these Rules applies to every ship to which these Rules apply.

#### *General*

22. Except in the case of open ships of Classes V and VI not exceeding 40 feet in length, and not proceeding on voyages to a point more than 3 miles from the starting point, every ship to which these Rules apply shall be provided with an efficient pumping plant capable of pumping from and draining any watertight compartment in the ship under all conditions likely to arise in practice after a casualty, whether or not the ship remains upright. Wing suction shall be provided if necessary for that purpose. Efficient arrangements shall be provided whereby water in any watertight compartment may find its way to the suction pipes. Efficient means shall be provided for draining water from all insulated holds and insulated between decks in such a ship.

#### *Number and Type of Bilge Pumps: Ships of Classes I and II*

23. (1) Every ship of Classes I and II shall be provided with pumps connected to the bilge main in accordance with the following table:

Length of Ship	Less than 300 ft.		300 ft. or more	
	Less than 30	30 and over	Less than 30	30 and over
Number of hand pumps of the crank type (may be replaced by one independent power pump)	2	—	—	—
Number of main engine pumps (may be replaced by one independent power pump)	1	1	1	1
Number of independent power pumps	1	3	2	3

(2) The aforesaid pumping plant shall be arranged as follows:

(a) in ships provided with two hand pumps of the crank type in compliance with the foregoing paragraph, one of such pumps shall be installed forward and the other aft;

(b) in all other ships of Classes I and II:

(i) one of the pumps shall be an efficient emergency pump of a submersible type having its source of power and the necessary controls situated above the ship's bulkhead deck; or



- (ii) the power pumps in the ship and their sources of power shall be so disposed throughout the ship's length that under any condition of flooding which the ship is required to withstand at least one such pump in an undamaged watertight compartment will be available.

*Number and Type of Bilge Pumps: Ships of Classes II(A) and III*

24. (1) Every ship of Classes II(A) and III shall be provided with bilge pumps in accordance with the following table:

Length of Ship in feet	Number of Pumps		
	Main Engine Pump*	Independent Power Pumps	Hand Pump†
Under 50	1	—	One of the lever type for each water-tight compartment, or one of the crank type.
50 and under 100	1	1	One of the lever type for each water-tight compartment, or one of the crank type.
100 and under 250	1	1	One of the crank type.
250 and under 300	1	1	Two of the crank type.
300 and over	1	2	—

\* The main engine pump may be replaced by one independent power pump.

† The hand pumps specified in this column may be replaced by one independent power pump.

(2) In every such ship of less than 300 feet but not less than 250 feet in length provided with two hand pumps of the crank type in accordance with the foregoing paragraph, in every such ship of 300 feet in length or more and in every ship of under 300 feet in length where the hand pump or pumps are replaced by an independent power pump, paragraph (2) of Rule 23 of these Rules shall apply to the pumping arrangements as it applies to the pumping arrangements in ships of Classes I and II.

*Number and Type of Bilge Pumps etc.: Ships of Classes IV to VI(A) inclusive*

25. (1) Every ship of Class IV shall be provided with a power bilge pump, which may be worked by the ship's main engines, and, in addition, a hand pump other than a hand pump of the lever type.

(2) Every ship of Classes V, VI and VI(A) shall be provided with bilge pumps and means for bailing as follows:

(a) Every such ship exceeding 60 feet in length shall be provided with a power pump, which may be worked by the main engine, and, in addition, a hand pump other than a hand pump of the lever type.

(b) Every such ship, being a decked ship not exceeding 60 feet in length, shall be provided with a hand pump other than a hand pump of the lever type.

(c) Every such ship, being a partially decked ship not exceeding 60 feet in length, shall be provided with a hand pump, and, in addition, two bailers or one bailer and one bucket.

(d) Every such ship, being an open ship exceeding 40 feet in length but not exceeding 60 feet in length, shall be provided with a hand pump, and, in addition, two bailers or one bailer and one bucket.

(e) Every ship of Classes V and VI, being an open ship not exceeding 40 feet in length, and proceeding beyond 3 miles from the starting point of her voyage, and every ship of Class VI(A), being an open ship not exceeding 40 feet in length, shall be provided with a hand pump, and, in addition, two bailers or one bailer and one bucket.

(f) Every ship of Classes V and VI being an open ship not exceeding 40 feet in length, and not proceeding on voyages more than 3 miles from the starting point, shall be provided with two bailers or one bailer and one bucket.

### *Requirements for Bilge Pumps and Bilge Suctions*

26. (1) Power bilge pumps fitted in any ship to which these Rules apply, shall where practicable be placed in separate watertight compartments so arranged or situated as not to be readily flooded by the same damage, and if the ship's engines and boilers are in two or more watertight compartments the bilge pumps there available shall be distributed through such compartments as far as possible.

(2) Every bilge pump provided in such a ship in compliance with these Rules shall be self-priming unless efficient means of priming are provided. Every such pump, other than a hand pump of the lever type and a pump provided for peak compartments only, shall, whether operated by hand or by power, be so arranged as to be capable of drawing water from any hold or any part of the machinery space in the ship.

(3) Every independent power bilge pump in such a ship shall be capable of giving a speed of water through the ship's main bilge pipe of not less than 400 feet per minute. Every such pump shall have a direct suction from the space in which it is situated. Provided that not more than two direct suctions shall be required in any one space. Every such suction shall be of a diameter not less than that of the ship's main bilge pipe. The direct suctions in the ship's machinery space shall be so arranged that water may be pumped from each side of the space through direct suctions to independent bilge pumps.

(4) There shall be provided in the stokehold of every such ship, being a coal burning ship, a flexible suction hose of sufficient length to reach from a fitting on an independent power bilge pump in the ship to each side of the stokehold bilges. The hose shall be in addition to the other bilge suctions required by this Rule, and shall have an internal diameter of 4 inches, or  $\frac{1}{2}$  inch larger than that of the largest branch bilge suction required by Rule 28 of these Rules, whichever is the less.

(5) Any main engine circulating pumps in such a ship shall be fitted with direct suction connections, provided with non-return valves, to the lowest drainage level in the ship's machinery space, or as near thereto as will satisfy the Minister in the case of that ship. Such connections shall be of a diameter at least two-thirds of that of the ship's main sea inlet and the open end thereof or the strainer, if any, attached thereto shall be accessible for clearing. If the boiler fuel may be coal and there is no watertight bulkhead between the ship's engines and boilers, a direct discharge overboard shall be fitted from at least one of the aforesaid pumps unless a by-pass is fitted to the circulating discharge thereof. The spindles of the ship's main sea inlet and of the direct suction valves shall extend well above the engine room platform.

(6) The hand bilge pumps in such a ship shall be workable from above the ship's bulkhead deck, if any, and shall be so arranged that the bucket and tail valve can be withdrawn for examination and overhaul under flooding conditions. If two hand pumps of the crank type are fitted in such a ship, a shut-off valve or cock operated from above the ship's bulkhead deck or non-return valves shall be provided to enable either of such pumps to be opened up without affecting the efficiency of the other.

### *Arrangement of Bilge Pipes*

27. (1) In every ship to which these Rules apply all pipes from the pumps for draining cargo spaces or any part of the machinery space shall be distinct from pipes which may be used for filling or emptying spaces in which water or oil is carried.

(2) Lead pipes shall not be fitted in connection with bilge pumps in such a ship in or under coal bunkers, oil fuel storage tanks or in any compartment in which oil settling tanks or oil fuel pumping units are situated.

(3) Bilge suction pipes in such a ship shall not be led through oil tanks unless the pipes are enclosed in an oiltight trunkway. Such pipes shall not be led through double bottom tanks.

(4) Such pipes shall be made with flanged joints and shall be thoroughly secured in position and protected where necessary against the risk of damage. Efficient expansion joints or bends shall be provided in each line of pipe, and where a connection is made at a bulkhead or elsewhere with a lead bend the radius of each bend and the distance between the axes of the straight parts of the pipes shall be not less than three times the diameter of the pipe and the length of any bend shall be not less than eight times that diameter.

### *Diameter of Bilge Suction Pipes*

28. (1) Subject to the provisions of paragraphs (2) and (3) of this Rule in every ship of Classes I to III, inclusive, and in every ship of Classes IV to VI(A), inclusive, which is required by Rule 25 of these Rules to be provided with a pump, the internal diameter of main and branch bilge suction pipes shall be determined to the nearest  $\frac{1}{4}$  inch calculated according to the following formulae:

$$d_m = \sqrt{\frac{L(B + D)}{2,500}} + 1$$
$$d_b = \sqrt{\frac{l(B + D)}{1,500}} + 1$$

where  $d_m$  = internal diameter of the main bilge suction pipes in inches.

$d_b$  = internal diameter of the branch bilge suction pipes in inches.

$L$  = length of ship in feet

$B$  = breadth of ship in feet

$D$  = moulded depth of ship at bulkhead deck in feet

$l$  = length of compartment in feet.

(2) No main bilge suction pipe in any ship of Classes I to III, inclusive, shall be less than  $2\frac{1}{4}$  inches in bore, and no branch suction pipe shall be less than 2 inches, or need be more than 4 inches, in bore.

(3) No bilge suction pipe in any ship of Classes IV to VI(A), inclusive, which is required by Rule 25 of these Rules to be provided with a pump, shall be less than  $1\frac{1}{4}$  inches in bore.

### *Precautions against flooding through Bilge Pipes*

29. (1) The bilge and ballast pumping systems in every ship to which Part II of these Rules applies shall be so arranged as to prevent water passing from the sea or from water ballast spaces into the ship's cargo spaces or into any part of the machinery space or from one watertight compartment in the ship to another. The bilge connection to any pump which effects suction from the sea or from water ballast spaces shall be made by means of either a non-return valve or a cock which cannot be opened at the same time to the bilges and to the sea or to the bilges and the water ballast spaces. Valves in bilge distribution boxes shall be of a non-return type. An arrangement of lock-up valves or of blank flanges shall be provided to prevent any deep tank in such a ship being inadvertently run up from the sea when it contains cargo or pumped out through a bilge pipe when it contains water ballast, and instructions for the working of such arrangement shall be conspicuously displayed nearby.

(2) Provision shall be made in every such ship to prevent the flooding of any watertight compartment served by a bilge suction pipe in the event of the pipe being severed or otherwise damaged, by collision or grounding, in any other watertight compartment. Where any part of such a pipe is situated nearer to the side of the ship than one-fifth of the mid-ship breadth of the ship measured at the level of the deepest subdivision load water line, or in any duct keel a non-return valve shall be fitted to the pipe in the watertight compartment containing the open end of the pipe.

### *Bilge Valves, Cocks, etc.*

30. (1) In every ship to which Part II of these Rules applies all distribution boxes, valves and cocks fitted in connection with the bilge pumping arrangements shall be in positions which are accessible at all times in ordinary circumstances and shall be so arranged that in the event of flooding one of the bilge pumps may operate on any watertight compartment in the ship. If in any such ship there is only one system of pipes common to all such pumps, the necessary valves or cocks for controlling the bilge suctions shall be capable of being operated from above the ship's bulkhead deck. If an emergency bilge pumping system is provided in addition to the main bilge pumping system it shall be independent of the main system and shall be so arranged that a pump is capable of being operated under flooding conditions on any watertight compartment.



Provided that in any ship of Class II(A) or Class III of under 100 feet in length provided with a hand pump of the lever type for each watertight compartment in accordance with the provisions of paragraph (1) of Rule 24 of these Rules, the valves and cocks on the bilge main for controlling the bilge suction need not be workable from above the ship's bulkhead deck if they are in the same compartment as a power pump.

(2) Every operating rod for bilge suction valves or cocks in every such ship shall be led as directly as possible and shall have an index plate at the position above the bulkhead deck from which it is operated showing the purpose served by the valve or cock and how it may be opened and closed. Every such rod passing through cargo or bunker spaces shall be protected against damage.

#### *Bilge Mud Boxes and Strum Boxes*

31. Bilge suction in the machinery space of every ship to which these Rules apply shall be led from readily accessible mud boxes placed wherever practicable above the level of the working floor of such space. The boxes shall have straight tailpipes to the bilges and covers secured in such a manner as will permit them to be readily opened and closed. The suction ends in hold spaces and tunnel wells shall be enclosed in strum boxes having perforations approximately  $\frac{1}{4}$  inch in diameter, and the combined area of such perforations shall be not less than twice that of the end of the suction pipe. Strum boxes shall be so constructed that they can be cleared without breaking any joint of the suction pipe.

#### *Sounding Pipes*

32. In every ship to which Part II of these Rules applies all tanks forming part of the structure of the ship and all watertight compartments, not being part of the machinery space, shall be provided with efficient sounding arrangements which shall be protected where necessary against damage. Where such arrangements consist of sounding pipes, a thick steel doubling plate shall be securely fixed below each sounding pipe for the sounding rod to strike upon. All such sounding pipes shall extend to positions above the ship's bulkhead deck which shall at all times be readily accessible. Sounding pipes for bilges, coffer dams and double bottom tanks, being bilges, coffer dams and tanks situated in the machinery space, shall so extend unless the upper ends of the pipes are accessible in ordinary circumstances and are furnished with cocks having parallel plugs with permanently secured handles so loaded that on being released they automatically close the cocks. Sounding pipes for the bilges of insulated holds shall be insulated and not less than  $2\frac{1}{2}$  inches in diameter.

### **PART IV**

#### **ELECTRICAL EQUIPMENT AND INSTALLATIONS**

##### *Application of Part IV*

33. This Part of these Rules applies to every ship to which these Rules apply.

##### *General*

34. (1) In every ship to which these Rules apply the electrical equipment and installations, other than the electrical means of propulsion, if any, shall be such that the electrically operated services essential for the safety of the ship and of persons on board can be maintained under emergency conditions.

(2) Without prejudice to the preceding provisions of this Rule, the electrical equipment and installations (including any electrical means of propulsion) in every such ship shall be such that the ship and all persons on board are protected against electrical hazards and shall conform with the relevant provisions of the Regulations for the Electrical Equipment of Ships issued by the Institution of Electrical Engineers and dated September, 1939, as amended by a supplement dated November, 1947, except in so far as such Regulations as so amended are inconsistent with these Rules.

*Main Generating Sets: Ships of Classes I to III, inclusive*

35. Every ship of Classes I to III, inclusive, being a ship in which electrical power is the only power for maintaining the auxiliary services essential for the propulsion or safety of the ship, shall be provided with not less than two main generating sets the power of which shall be sufficient to operate the aforesaid services in the event of anyone of the sets being out of service. Arrangements shall be made which will safeguard such sets from being rendered inoperative in the event of the partial flooding of the ship's machinery space through leakage from a damaged compartment or otherwise.

*Emergency Source of Electrical Power: Ships of Classes I, II and II(A)*

36. (1) In every ship of Classes I, II and II(A) there shall be provided in a position above the bulkhead deck outside the machinery casings a self-contained emergency source of electrical power capable of operating simultaneously for a period of 36 hours, or for such shorter period as the Minister may permit in the case of any ship regularly engaged on voyages of short duration,

- (a) the ship's emergency bilge pump, if it is electrically operated;
- (b) the ship's watertight doors, if they are electrically operated;
- (c) the ship's emergency lights at every boat station on deck and overside, in all alleyways, stairways and exits, in the machinery space, in the control stations where radio, main navigating and central fire recording equipments are situated, and in the place where the emergency generator, if any, is situated;
- (d) the ship's navigation lights, if operated solely by electric power; and
- (e) all communication equipment and signals which may be required in an emergency, if they are electrically operated from the ship's main generating sets.

(2) The emergency source of electrical power may be either an accumulator battery capable of complying with paragraph (1) of this Rule without being recharged or suffering an excessive voltage drop, or a generator driven by a compression ignition engine with an independent fuel supply and with efficient starting arrangements. The fuel provided for such engine shall have a flash point of not less than 110°F.

(3) The emergency source of electrical power shall be so arranged that it will operate efficiently when the ship is listed 22½° and when the trim of the ship is 10° from an even keel.

(4) (a) If the emergency source of electrical power is an accumulator battery, the arrangements shall be such that the ship's emergency lighting system will come into operation automatically in the event of the failure of the main source of power for the ship's main lighting system.

(b) If the emergency source of electrical power is a generator, an accumulator battery shall be provided as a temporary source of electrical power, so arranged as to come into operation automatically in the event of a failure of the main or emergency source of electrical power, and of sufficient capacity:

- (i) to operate the ship's emergency lighting system continuously for half an hour; and
  - (ii) while such lighting system is in operation, to close the ship's watertight doors if they are electrically operated, but not necessarily to close all of such doors simultaneously.
- (c) Means shall be provided by which the automatic arrangements referred to in this paragraph can be tested.

*Emergency Source of Electrical Power: Ships of Class III*

37. (1) In any ship of Class III which is provided with an emergency bilge pump compliance with paragraph (2) of Rule 24 of these Rules, being an electrically operated pump, there shall be provided in a position above the bulkhead deck outside the machinery casings a self-contained emergency source of electrical power capable of operating the pump for a period of 24 hours.

(2) The emergency source of electrical power may be either an accumulator battery capable of complying with paragraph (1) of this Rule without being recharged or suffering an excessive voltage drop, or a generator driven by a compression ignition engine with an independent fuel supply and with efficient starting arrangements. The fuel provided for such engine shall have a flash point of not less than 110°F.

(3) Paragraph (3) of Rule 36 of these Rules shall apply to such emergency source of electrical power as it applies to the emergency source of electrical power provided in ships of Classes I, II and II(A).

#### *Distribution Systems*

38. (1) In every ship to which these Rules apply every open-type switchboard shall be arranged so as to allow ready access to the back and front thereof without danger to any person who in the course of his duties may inspect or repair the switchboard or its connections or operate the devices thereon. The sides and backs of the switchboard shall be guarded by a hand rail, wire netting, expanded metal or other equally efficient means of protection and a non-conducting mat or grating shall be provided as a floor covering. No exposed parts which may have a voltage to earth exceeding 250 volts direct current or 150 volts alternating current shall be installed on the face of any switchboard or control panel.

(2) Hull return shall not be used in any such ship for the power, heat and light distribution systems thereof.

(3) If, in any such ship, two or more generating sets may be in operation at the same time for maintaining the auxiliary services essential for the propulsion or safety of the ship, provision shall be made for the sets to operate in parallel and means shall be provided so that in the event of overload or a partial failure of the power supply the services not essential to the propulsion and safety of the ship will be cut out first, the services essential for those purposes being retained in circuit with such of the generators as may remain in service.

(4) In every such ship any electrically operated steering gear shall be served by two sets of feeder cables from the ship's main switchboard. Such sets of feeder cables shall be separated from each other throughout their length as widely as practicable. Each feeder cable shall have a capacity adequate for serving all motors which may operate simultaneously in connection with steering gear. Such cables and motors shall be protected by fuses, circuit breakers or other similar devices against short circuits, but shall not be so protected against lesser loads.

(5) If in any such ship the power supply for an automatic sprinkler system, requiring not less than two sources of power supply for sea-water pumps, air compressors and automatic alarms, is electrical, such power supply shall be taken through the emergency switchboard by a feeder reserved solely for that purpose. There shall be no switch in the circuit other than that at the switchboard. The switch shall be clearly and permanently labelled to indicate its purpose and to indicate that it shall normally be kept closed.

(6) In every such ship the main and emergency feeder cables shall be separated vertically and horizontally as widely as practicable.

#### *General Electrical Precautions*

39. (1) In every ship to which these Rules apply all exposed metal parts of electrical equipment which are not intended to have a voltage above that of earth but which may have such a voltage under fault conditions shall be earthed, and all such equipment shall be so constructed and installed that there will be no danger of injury to a person handling it in a proper manner. The metal frames of all portable lamps and tools and other portable apparatus provided in such a ship and operating on an electric supply of a voltage of 100 volts or more shall be earthed through a conductor in the supply cable.

(2) Every electrical cable in such a ship shall, at every position at which an electrical fault may cause a fire, be covered by metal sheaths, metal armour or other equally effective means of protection. All metal sheaths and metal armour of electrical cable in such a ship shall be electrically continuous and shall be earthed.



(3) Wiring in every such ship shall be supported in such a manner as to avoid chafing and other injury.

(4) In every such ship the joints in all electrical conductors shall be made only in junction or outlet boxes except in the case of low voltage communication circuits. All such junctions or outlet boxes shall be so constructed as to prevent the spread of fire therefrom.

(5) All lighting fittings in every such ship shall be so arranged as to prevent rises in temperature which would be injurious to the electrical wiring thereof or which would result in a risk of fire in the surrounding material.

(6) Every electric space-heater forming part of the equipment of such a ship shall be fixed in position and shall be so constructed as to reduce the risk of fire to a minimum. No such heater shall be constructed with an element so exposed that clothing, curtains, or other similar material can be scorched or set on fire by heat from the element.

(7) In every such ship each separate electrical circuit, other than a circuit which operates the ship's steering gear, shall be protected against overload. There shall be clearly and permanently indicated on or near each overload protective device the current carrying capacity of the circuit which it protects and the rating or setting of the device.

(8) In every such ship all accumulator batteries shall be housed in boxes or compartments which are so constructed as to protect the batteries from damage and are so ventilated as to minimise the accumulation of explosive gas. Electrical devices which are likely to arc shall not be installed in any compartment used to house accumulator batteries unless such devices are flame-proof.

#### *Spare Parts and Tools*

40. Every ship of Classes I, II and II(A) shall be provided with an adequate quantity of replacements for those parts of the ship's electrical equipment and installations which, having regard to the intended service of the ship, it would be essential for the safety of the ship and of persons on board to replace in the event of failure while the ship is at sea, together with such tools as are necessary for the fitting of those replacements.

### **PART V**

#### **FIRE PROTECTION: SHIPS OF CLASSES I, II AND II(A)**

##### *Application of Part V*

41. This Part of these Rules applies to ships of Classes I, II and II(A).

##### *Exemption from Part V*

42. (1) The Minister may exempt from any of the requirements of Rules 47 to 54, inclusive and 56 to 60, inclusive, of these Rules any ship carrying not more than 36 passengers if he is satisfied that the ship is fitted with an efficient fire detection system capable of giving a visible and audible alarm signal at one or more points in the ship so as to come rapidly to the notice of the master and crew of the ship, which will indicate the presence and position of any fire in any accommodation space or service space, other than a space which in the opinion of the Minister affords no substantial fire risk.

(2) The Minister may further exempt any ship of Class II or II(A) from the requirements of this Part of these Rules to the extent that he is satisfied that compliance therewith is unreasonable or impracticable by reason of the intended service of the ship

##### *Exhibition of Plans*

43. In every ship to which this Part of these Rules applies there shall be provided for the guidance of the master of the ship plans showing for each deck the sections of the

ship enclosed by "A" Class divisions and the sections of the ship enclosed by "B" Class divisions, together with particulars of the fire alarm and fire detecting systems, sprinkler installations and fire extinguishing appliances provided in the ship, the means of entry into and exit from the various compartments and decks in the ship, and of the ship's ventilating system, including in particular the positions of the dampers thereof and the identification numbers of the ventilation fans serving each section of the ship. Such plans shall be protected by glass or similar material and shall be permanently affixed to a bulkhead, table or desk near the place from which the ship is normally navigated.

#### *"A" and "B" Class Divisions*

44. (1) Every "A" Class division required by these Rules shall be constructed of steel or similar material, in either case stiffened so as to be capable of preventing the passage of smoke and flame throughout a standard fire test of 60 minutes duration. The division shall have an adequate insulating value having regard to the nature of the spaces adjacent thereto, and if the division is between spaces either of which contains adjacent combustible material it shall be so insulated that if either face of the division is exposed to a standard fire test of 60 minutes duration the average temperature on the unexposed face of the division will not increase at any time during the test by more than 250°F. (139°C.) above the initial temperature on that face nor shall the temperature at any one point thereon increase by more than 325°F. (180°C.) above the initial temperature.

(2) Every "B" Class division required by these Rules shall be capable of preventing the passage of smoke and flame throughout a standard fire test of 30 minutes duration. Every such division shall have an adequate insulating value having regard to the nature of the spaces adjacent thereto. The division shall be so constructed that if either face thereof is exposed to a standard fire test of 30 minutes duration the average temperature on the unexposed face of the division will not increase by more than 250°F. (139°C.) above the initial temperature on that face, nor shall the temperature at any one point thereon increase by more than 325°F. (180°C.) above the initial temperature. Provided that any division which is constructed wholly of incombustible material shall be required to comply with the foregoing requirement relating to increase of temperature only during the first 15 minutes of a standard fire test.

(3) The Minister may exempt any ship from the requirements of this Rule relating to insulation to the extent that he is satisfied that compliance therewith is unnecessary having regard to the degree of fire hazard present.

#### *Structure of the Ship*

45. (1) The hull, superstructure, structural bulkheads, decks and deckhouses of every ship to which this Part of these Rules applies shall be constructed of steel. The Minister may exempt any ship wholly or in part from the requirement of this paragraph if he is satisfied that the aforesaid parts of the ship are constructed of material equally resistant to fire.

(2) The hull, superstructure and deckhouses of every ship to which this Part of these Rules applies shall be subdivided by bulkheads consisting of "A" Class divisions into main vertical zones. The mean length of each zone, above the bulkhead deck, shall not exceed 131 feet. Any steps in such bulkheads shall consist of "A" Class divisions.

(3) Any portions of such divisions which extend above the ship's bulkhead deck shall, whenever possible, be in line with watertight subdivision bulkheads situated immediately below the bulkhead deck and shall extend from deck to deck and to the ship's shell plating and, in the case of a deckhouse, to the external plating thereof.

(4) The Minister may exempt any ship from the requirements of paragraphs (2) and (3) of this Rule to the extent that he is satisfied that compliance therewith is incompatible with the purpose for which the ship is designed and that other equally effective methods of fire protection have been adopted in the ship.

### *Openings in "A" Class Divisions*

46. (1) If, in any ship to which this Part of these Rules applies, any "A" Class division is pierced for the passage of electric cables, pipes, trunkways, girders or beams, or for other purposes, the arrangements shall be such that the effectiveness of the division in resisting fire is not thereby impaired.

(2) Dampers shall be fitted in any trunkways which pass through an "A" Class division and shall be provided with a suitable means of local control capable of being operated from both sides of the division. The positions from which such means of control may be operated shall be readily accessible and shall be permanently marked in red. Indicators shall be provided to show whether the dampers are open or shut.

(3) Any opening in such a division shall be provided with means of closure permanently attached to the division. The means of closure shall be as effective as the division in resisting fire.

(4) Any door in such a division shall be so constructed that it can be opened and closed by one person from either side of the division. The door and the means of keeping it closed shall be as effective as the division in resisting fire. Provided that a watertight door shall not be required to be insulated. If the division is constructed in compliance with paragraph (2) of Rule 45 of these Rules and any door therein is not a watertight door, such door shall be self-closing and shall be provided with a device by which it may readily be released from the open position.

### *Separation of Accommodation Spaces from other Enclosed Spaces*

47. In every ship to which this Part of these Rules applies the bulkheads and decks separating accommodation spaces from other enclosed spaces shall consist of "A" Class divisions.

### *Protection of Stairways*

48. (1) In every ship to which this Part of these Rules applies every stairway within an accommodation space or service space shall be of steel frame construction and shall lie within an enclosure constructed of "A" Class divisions. Provided that

(a) a stairway serving only two decks shall not be required to be enclosed by "A" Class divisions at more than one deck;

(b) a stairway in a public room shall not be required to be so enclosed if it lies wholly within the room.

The Minister may exempt any ship, being a ship in which Method II of fire protection, within the meaning of Rule 56 of these Rules, has been adopted, from the requirements of this paragraph in relation to any stairway which he is satisfied is an auxiliary stairway adequately protected by sprinklers.

(2) Every opening in a bulkhead forming part of a stairway enclosure shall be provided with a means of closure which shall be permanently attached thereto. The means of closure shall be as effective as the bulkhead in resisting fire, and shall be self-closing unless it is a watertight door.

(3) Every stairway enclosure in such a ship shall communicate directly with the corridors adjacent thereto and shall have an area sufficient to prevent congestion, having regard to the number of persons likely to use the stairway in an emergency. Every such enclosure shall contain as little accommodation space or service space as is practicable in the circumstances.

### *Protection of Lifts and Vertical Trunks for Light and Air*

49. (1) In every ship to which this Part of these Rules applies every lift trunk, and every light-and-air and similar trunk in an accommodation space or service space, shall be constructed of "A" Class divisions. Provided that a lift trunk within a stairway enclosure shall not be required to be insulated. Every door in such a trunk shall be constructed of steel or other incombustible material and shall be as effective as the trunk in resisting fire.



(2) Every lift trunk in such a ship shall be so fitted as to prevent the passage of smoke and flame from one between decks to another and shall be provided with means of closure which will enable draught and smoke to be controlled.

(3) If in such a ship a light-and-air or similar trunk communicates with more than one between-deck space and smoke and flame may be conducted from one between decks to another, smoke shutters shall be fitted so as to enable each such space to be isolated in the event of fire.

(4) Every other trunk in such a ship shall be so constructed as not to afford a passage for fire from one between decks or compartment to another.

#### *Protection of Control Stations*

50. (1) Every control station in a ship to which this Part of these Rules applies shall be separated from the rest of the ship by bulkheads and decks consisting of "A" Class divisions.

(2) The radiotelegraph room in such a ship shall not be situated directly above any stairway.

#### *Protection of Store Rooms, etc.*

51. (1) In every ship to which this Part of these Rules applies the boundary bulkheads separating a galley, baggage room, mail room, store room, paint room, lamp room, or any similar space from any other space shall consist of "A" Class divisions.

(2) Spaces appropriated for the storage of highly inflammable stores shall be so constructed and situated as to minimise the danger to persons on board in the event of fire.

#### *Deck Sheathing*

52. In every ship to which this Part of these Rules applies any permanent deck sheathing within an accommodation space, service space, control station, stairway or corridor shall be such as will not readily ignite.

#### *Ventilation Systems*

53. (1) The inlets of every air supply system and the outlets of every air exhaust system in every ship to which this Part of these Rules applies shall have readily accessible means by which they can be closed in the event of fire. Wherever practicable the system of ducts leading from each ventilating fan shall be within one main vertical zone.

(2) Every such ship shall be equipped with two master controls, situated as far apart as is practicable, either of which shall be capable of stopping all the fans in the power ventilation systems of the ship, other than the ventilation systems in the machinery space. Every power ventilation system serving the machinery space shall have two master controls, one of which shall be capable of being operated from outside such space. Any exhaust ducts from galley ranges in such a ship shall be constructed of "A" Class divisions which shall be insulated where the ducts pass through accommodation spaces or service spaces.

#### *Miscellaneous Items of Fire Protection*

54. (1) Every air space enclosed behind a ceiling, panel or lining in the accommodation spaces or service spaces of a ship to which this Part of these Rules applies shall be divided by close fitting draught-stops spaced not more than 45 feet apart in the fore and aft direction, and shall be closed at each deck.

(2) Every such ceiling, panel and lining shall be so constructed as to enable a fire patrol to detect any smoke originating in a concealed or inaccessible space, without impairing the efficiency of the fire protection of the ship.

(3) In every such ship the concealed surfaces of every bulkhead, lining, panelling, stairway, wood grounds and other structure in accommodation spaces and service spaces shall be such that they will be surfaces of low flame spread within the meaning of Amendment No. 2 dated July, 1945, to the British Standard Definitions for Fire-Resistance, Incombustibility and Non-Inflammability of Building Materials and Structures (B.S. 476: 1932).

(4) In such a ship, paints, varnishes or similar preparations shall not be applied if they contain a nitro-cellulose base, and fabrics containing nitro-cellulose shall not be fitted.

(5) In such a ship overboard scuppers, sanitary discharges or other outlets shall not be made of lead if they are close to the water line or in such a position that the fusing of the lead in the event of fire would give rise to a danger of flooding.

(6) In such a ship the use of wood for the construction and equipment of galleys, bakeries and main pantries shall be restricted so far as is practicable.

(7) Every window and side scuttle in the accommodation spaces and service spaces of such a ship shall be constructed with metal frames. The glass therein shall be retained by a metal ring or bead. If the window or side scuttle is in a position in which the fusion of the frame, ring or bead, may give rise to a danger of flooding, the frame, ring or bead, as the case may be, shall consist of metal which is not likely to fuse in the event of fire. Every window and side scuttle in such a ship opening on to a corridor or stairway shall be as effective in resisting fire as the bulkhead in which it is fitted.

#### *Provision for Cinematograph Exhibitions*

55. If any inflammable film is carried in a ship to which this Part of these Rules applies for exhibition therein the ship and the cinematograph equipment provided therein shall comply with the requirements specified in the Fifth Schedule to these Rules.

#### *Methods of Fire Protection*

56. The accommodation spaces and service spaces in every ship to which this Part of these Rules applies shall be constructed in accordance with one of the following methods of fire protection and shall comply with such of the following requirements of this Part of these Rules as are expressed to apply to ships in which that method has been adopted:

Method I: The construction in the accommodation spaces and service spaces of a system of internal bulkheading consisting of "B" Class divisions, together with an automatic fire alarm and fire detection system in these spaces.

Method II: The fitting of an automatic sprinkler, fire detection and fire alarm system in the accommodation spaces and service spaces.

Method III: The subdivision of the accommodation spaces and service spaces by "A" Class and "B" Class divisions, together with the fitting of an automatic fire alarm and fire detection system in all accommodation spaces and service spaces and a restriction of the provision of combustible material in these spaces.

#### *Bulkheads within Main Vertical Zones*

(Methods I and III)

57. (1) Method I:

(a) Every bulkhead within the accommodation spaces or service spaces of a ship in which Method I of fire protection has been adopted, not being a bulkhead required by these Rules to consist of "A" Class divisions, shall consist of "B" Class divisions. The bulkheads shall be joined together in a manner which will ensure the maximum resistance to fire. If such a ship carries more than 100 passengers, the said "B" Class divisions shall be constructed of incombustible material but, subject to the provisions of paragraph (1)(b) of Rule 60 of these Rules, may be faced with combustible material.

(b) Every such bulkhead shall extend from deck to deck. Provided that a bulkhead, other than a corridor bulkhead, may terminate at a ceiling consisting of incombustible material.

(c) Where the ship's shell plating forms the boundary of an accommodation space or a service space, the adjacent transverse bulkheads shall extend to the shell plating. Where the external plating of a deckhouse forms the boundary of an accommodation space or service space, the adjacent transverse and longitudinal bulkheads shall extend to the external plating. Provided that any such bulkhead, other than a corridor bulkhead, may terminate at a lining consisting of incombustible material.

(d) Any ventilation opening in a corridor bulkhead shall be in the lower part of the bulkhead wherever practicable and shall be provided with a grille constructed of incombustible material.

(2) Method III:

(a) Bulkheads within the accommodation spaces and service spaces of every ship in which Method III of fire protection has been adopted, not being a bulkhead required by these Rules to consist of "A" Class divisions, shall be constructed of "B" Class divisions so as to form a continuous network of "B" Class divisions or, together with such bulkheads as are constructed of "A" Class divisions, a continuous network of "A" and "B" Class divisions. The area of any one compartment formed by such network shall not exceed 1,600 square feet and shall wherever practicable not exceed 1,300 square feet.

(b) Every public room in such a ship, being a space without interior subdivisions, shall, except at the shell plating of the ship or the external plating of a deckhouse, be bounded by bulkheads consisting of "B" Class divisions unless the bulkheads enclosing the room are required by these Rules to consist of "A" Class divisions.

(c) Every corridor bulkhead in such a ship shall consist of "B" Class divisions unless it is required by these Rules to consist of "A" Class divisions and shall extend from deck to deck. Provided that ventilation openings having grilles of incombustible material may be installed in such bulkhead at points where no ceilings are fitted above such bulkhead or where the ceilings there fitted are constructed of incombustible material.

(d) If such a ship carries more than 100 passengers, every "B" Class division constructed in accordance with this paragraph shall be constructed of incombustible material but, subject to the provisions of paragraph (2) of Rule 60 of these Rules, may be faced with combustible material. If such a ship carries 100 passengers or less, every such division shall have an incombustible core or shall be assembled with internal layers of sheet asbestos or similar incombustible material, and in either case shall comply with the requirements of paragraph (2) of Rule 44 of these Rules as if it were constructed wholly of combustible material.

*Automatic Fire Alarm and Fire Detection Systems*  
(Methods I and III)

58. (1) In every ship in which Method I or Method III of fire protection has been adopted a fire alarm and fire detection system shall be installed which will detect the presence of fire in any accommodation space or service space and will indicate the presence and position of the fire by a signal given at one or more points in the ship so as to come rapidly to the notice of the master and crew of the ship.

(2) The Minister may exempt any ship from the requirements of this Rule to the extent that he is satisfied that the accommodation spaces and service spaces therein afford no substantial fire risk.

*Automatic Sprinkler, Fire Alarm and Fire Detection Systems*  
(Method II)

59. (1) In every ship in which Method II of fire protection has been adopted an automatic sprinkler and fire alarm and fire detection system complying with the requirements specified in the Sixth Schedule to these Rules shall be installed and so arranged as to protect all accommodation spaces and service spaces in the ship.

(2) The Minister may exempt any ship from the requirements of this Rule:

(a) to the extent that he is satisfied that the accommodation spaces and service spaces therein afford no substantial fire risk;

(b) in respect of any baggage room or store room which he is satisfied is provided with adequate arrangements for the detection of fire or for the smothering of fire by gas or steam.



*Restriction of Combustible Material, etc.*

(Methods I and III)

**60. (1) Method I:**

(a) In every ship in which Method I of fire protection has been adopted all linings, grounds, ceilings and insulation shall consist of incombustible material except in cargo spaces, mail rooms, bullion rooms, baggage rooms and refrigerated store rooms. Provided that the linings, grounds and ceilings in ships carrying not more than 100 passengers may be constructed of combustible material having the same fire-resisting properties as the material of the bulkheads enclosing the spaces in which they are situated.

(b) The total volume of combustible materials installed as facings, mouldings, decorations or veneers in any accommodation space or service space in a ship in which Method I of fire protection has been adopted, being a ship carrying more than 100 passengers, shall not exceed a volume equal to that of a veneer of one-tenth of an inch on the combined area of the walls and ceiling of such space. Any facings, mouldings, decorations or veneers installed in the corridors or stairway enclosures in such a ship shall consist of incombustible materials.

**(2) Method III:**

In every ship in which Method III of fire protection has been adopted the provision of combustible materials for linings, grounds, ceilings, fittings and furnishings in any space in the accommodation spaces or service spaces shall be restricted to the minimum compatible with the use for which that space is appropriated. In the public rooms in such a ship the grounds and supports for the linings and ceilings shall be constructed of steel or other material equally effective in resisting fire. All exposed surfaces and their coatings in the accommodation spaces of such a ship shall be surfaces of low flame spread within the meaning of paragraph (3) of Rule 54 of these Rules.

**PART V(A)**

**FIRE PROTECTION: SHIPS OF CLASSES III TO VI(A) INCLUSIVE**

*Application of Part V(A)*

**61.** This Part of these Rules applies to ships of Classes III to VI(A), inclusive.

*Structure of the Ship*

**62.** The hull, superstructure, structural bulkheads, decks and deckhouses of every ship of Classes III and IV shall be constructed of steel. The Minister may exempt any ship wholly or in part from the requirement of this Rule.

*Divisions*

**63.** In every ship to which this Part of these Rules applies, being a ship fitted with internal combustion propelling machinery or oil-fired boilers, the accommodation spaces shall be separated from machinery spaces by "A" Class divisions.

**PART VI**

**BOILERS AND MACHINERY**

*Application of Part VI*

**64.** This Part of these Rules applies to every ship to which these Rules apply.

*General*

**65.** The boilers and machinery provided in any ship to which these Rules apply shall be of a design and construction adequate for the service for which they are intended, and shall be so installed and protected as not to constitute a danger to persons on board. Without prejudice to the generality of the foregoing, means shall be provided which will prevent overpressure in any part of such boilers and machinery, and in particular every boiler and other pressure vessel used for generating steam shall be provided with not less than two safety valves.

### *Power for Going Astern*

66. The propelling machinery of every ship to which these Rules apply shall have sufficient power for going astern, and the propulsion of the ship shall be capable of being reversed with sufficient speed, to enable the ship to be properly handled.

### *Boilers, Superheaters, Economisers, Evaporators, Distillers and Other Steam or Water Pressure Vessels*

67. (1) In every ship to which these Rules apply, every boiler, superheater, economiser, evaporator, distiller and other steam or water pressure vessel, and their respective mountings, shall be so designed and constructed as to withstand the maximum working stresses to which they may be subjected, with a factor of safety which is adequate, having regard to:

- (a) their design and the material of which they are constructed;
- (b) the purpose for which they are intended to be used; and
- (c) the working conditions under which they are intended to be used.

Provision shall be made which will facilitate the cleaning and inspection of such pressure vessels.

(2) Without prejudice to the generality of the foregoing:

- (a) every such boiler and superheater, when put into service for the first time in such a ship, shall be capable of withstanding for a period of not less than thirty minutes a test by hydraulic pressure to the following extent:
  - (i) to one and one-half times the maximum working pressure of the boiler plus 50 lb. per square inch, if such working pressure is more than 100 lb. per square inch; or
  - (ii) to twice the maximum working pressure of the boiler, if such working pressure is 100 lb. per square inch or less;
- (b) every such boiler and superheater, being a boiler or superheater of such dimensions and form that an adequate internal examination thereof can be made, shall, at any time after first being put into service in such a ship, be capable of withstanding for a period of not less than thirty minutes a test by hydraulic pressure to one and one-half times the maximum working pressure of the boiler;
- (c) every such boiler and superheater, being a boiler or superheater of such dimensions and form that an adequate internal examination thereof cannot be made, shall, at any time after first being put into service in any such ship, be capable of withstanding a test by hydraulic pressure to the extent specified in sub-paragraph (a) of this paragraph.

(3) Every such economiser shall be capable at all times of withstanding a test by hydraulic pressure to the following extent:

- (a) if the economiser cannot be shut off from the boiler, to the same extent as is required by sub-paragraph (a) of paragraph (2) of this Rule in relation to the boiler to which the economiser is connected; or
- (b) if the economiser can be shut off from the boiler, to one and one-half times the maximum working pressure of the safety valve of the economiser plus 50 lb. per square inch.

(4) Each mounting of every such boiler, not being a mounting in the boiler feed system, shall be capable of withstanding a test by hydraulic pressure to twice the maximum working pressure of the boiler.

Each mounting of every such superheater and economiser, not being a mounting in the boiler feed system, shall be capable of withstanding a test by hydraulic pressure to twice the maximum working pressure of the boiler to which the superheater or economiser, as the case may be, is connected.

## *Machinery*

68. (1) In every ship to which these Rules apply a governor shall be provided for any ahead turbine or set of turbines which drives a single gear wheel forming part of the main propelling machinery, so as to shut off the steam automatically in the event of overspeed. A hand-trip gear shall also be provided for that purpose.

(2) In every such ship means shall be provided which will shut off automatically the steam from any ahead turbine, and any other machinery served by the same lubricating oil system as the turbine, in the event of any failure of that system.

(3) (a) The nozzle boxes of every impulse steam turbine fitted in such a ship shall be capable of withstanding a test by hydraulic pressure to one and one-half times the maximum pressure to which they may be subjected in service.

(b) The steam casings of every turbine fitted in such a ship shall be capable of withstanding a test by hydraulic pressure to one and one-half times the maximum working pressure in such casings or 30 lb. per square inch, whichever shall be the greater.

(4) The cylinders of all steam reciprocating machinery fitted in such a ship shall be capable of withstanding a test by hydraulic pressure to the following extent:

<i>Type of engine</i>	<i>Cylinder pressure</i>	<i>Pressure of test</i>
Compound expansion	High	$1\frac{1}{2} \times \text{M.W.P.}$
Compound expansion	Low	30 lb. per square inch
Triple expansion	High	$1\frac{1}{2} \times \text{M.W.P.}$
Triple expansion	Intermediate	$\frac{3}{4} \times \text{M.W.P.}$
Triple expansion	Low	30 lb. per square inch
Quadruple expansion	High	$1\frac{1}{2} \times \text{M.W.P.}$
Quadruple expansion	1st intermediate	$\frac{3}{4} \times \text{M.W.P.}$
Quadruple expansion	2nd intermediate	$\frac{2}{3} \times \text{M.W.P.}$
Quadruple expansion	Low	30 lb. per square inch

In the foregoing table "M.W.P." means, in relation to a cylinder, the maximum working pressure of the boiler to which the machinery of which the cylinder forms a part is connected.

(5) The cylinder liners of every compression ignition engine fitted in such a ship, shall be capable of withstanding a test by hydraulic pressure to 100 lb. per square inch. The cooling passages of the cylinders, covers and other fluid-cooled parts of such engine shall be capable of withstanding a test by hydraulic pressure to 30 lb. per square inch.

(6) Subject to the provisions of paragraph (2) of Rule 36 of these Rules and paragraph (2) of Rule 37 thereof, no machinery or boilers shall be fitted in such a ship which are designed to be operated by means of oil fuel having a flash point of less than 150°F.

## *Shafts*

69. In every ship to which these Rules apply every shaft shall be so designed and constructed that it will withstand the maximum working stresses to which it may be subjected, with a factor of safety which is adequate having regard to:

- (a) the material of which it is constructed;
- (b) the service for which it is intended; and
- (c) the type of the engines by which it is driven or of which it forms a part.

## *Boiler Feed Systems*

70. (1) Every boiler fitted in a ship to which these Rules apply shall be provided with not less than two efficient and separate feed systems so arranged that either of such systems may be opened up for inspection or overhaul without affecting the efficiency of the other. Means shall be provided which will prevent overpressure in any part of the systems.

(2) If it is possible for oil to enter the feed water system in such a ship, the arrangements for supplying boiler feed water shall provide for the interception of oil in the feed water.



(3) Every feed check valve, fitting and pipe through which feed water passes from a pump to the boilers in such a ship shall be of efficient design and of sufficient strength to withstand with an adequate factor of safety the maximum working pressure to which the feed line may be subjected. Such valve, fitting and pipe shall also be capable of withstanding a test by hydraulic pressure to two and one-half times the maximum working pressure of the boiler to which they are connected or twice the maximum working pressure of the feed line, whichever shall be the greater. The feed pipes shall be adequately supported.

#### *Steam Pipe Systems*

71. (1) In every ship to which these Rules apply, every steam pipe and every fitting connected thereto through which steam may pass shall be so designed and constructed as to withstand the maximum working stresses to which it may be subjected, with a factor of safety which is adequate having regard to:

- (a) the material of which it is constructed; and
- (b) the working conditions under which it will be used.

The steam pipes shall be adequately supported.

(2) Without prejudice to the generality of the foregoing, every such steam pipe and fitting shall be capable of withstanding a test by hydraulic pressure to twice the maximum working pressure to which it may be subjected.

(3) Provision shall be made which will avoid excessive stress likely to lead to the failure of any such steam pipe, whether by reason of variation in temperature, vibration or otherwise.

(4) Efficient means shall be provided for draining every such steam pipe so as to ensure that the interior of the pipe is kept free of water and that water hammer action will not occur under any conditions likely to arise in the course of the intended service of the ship.

(5) If, in any ship to which these Rules apply, a steam pipe may receive steam from any source at a higher pressure than it can withstand with an adequate factor of safety, an efficient reducing valve, relief valve and pressure gauge shall be fitted to such pipe.

#### *Air Pressure Systems*

72. (1) Every ship to which these Rules apply, being a ship propelled by compression ignition engines designed to be started by compressed air, shall be provided with at least two starting air compressors, each of which shall be of efficient design and of sufficient strength and capacity for the service for which it is intended. Provided that in ships of Classes III to VI(A), inclusive, only one such compressor shall be required.

(2) Without prejudice to the generality of the foregoing:

- (a) every cylinder forming part of an air compressor in a ship to which these Rules apply shall be capable of withstanding a test by hydraulic pressure to twice its maximum working pressure;
- (b) every cooling coil of each stage forming part of such air compressor shall be capable of withstanding a test by hydraulic pressure to twice the maximum working pressure of that stage;
- (c) the cooling passages of such air compressor and the cooler casings thereof shall be capable of withstanding a test by hydraulic pressure to 30 lb. per square inch; and
- (d) a relief valve shall be fitted in the high pressure discharge from such compressor, and a relief valve or safety diaphragm shall be fitted on the casing of the high pressure cooler.

(3) Every such ship shall be provided with a starting air compressor which can be put into operation without a supply of compressed air, and which shall be additional to the compressors required by paragraph (1) of this Rule. Provided that such additional compressor shall not be required if a compressor fitted in accordance with the said paragraph can be put into operation without a supply of compressed air.

(4) Every ship to which these Rules apply, being a ship propelled by compression ignition engines designed to start by compressed air, shall be provided with at least two air receivers, which shall be of such aggregate capacity that, when they are filled with compressed air, the air contained therein will be sufficient to start each of the ship's main engines twelve times if such engines are reversible, and six times if such engines are non-reversible. Provided that in ships of Classes III to VI(A), inclusive, only one such air receiver shall be required.

(5) Every air receiver provided in such a ship shall be so designed and constructed as to withstand the maximum working stresses to which it may be subjected, with a factor of safety which is adequate having regard to:

- (a) its design and the material of which it is constructed; and
- (b) the working conditions under which it is intended to be used.

Without prejudice to the generality of the foregoing, every air receiver shall be capable of withstanding a test by hydraulic pressure to the extent set forth in the following table:

<i>Construction of Receiver</i>	<i>M.W.P. of Receiver</i>	<i>Pressure of test</i>
Riveted	Not over 100	$2 \times \text{M.W.P.}$
Riveted	Over 100 but not over 300	$1\frac{1}{2} \times \text{M.W.P.} + 50$
Riveted	Over 300	$\text{M.W.P.} + 200$
Fusion welded	Not over 100	$2 \times \text{M.W.P.}$
Fusion welded	Over 100	$1\frac{1}{2} \times \text{M.W.P.} + 50$

In the foregoing table pressures are indicated in lb. per square inch and "M.W.P." means maximum working pressure.

(6) Every air bottle provided in a ship to which these Rules apply shall be of efficient design and shall be made of seamless steel tube with the ends of the bottle worked down from the tube or shall be of equally efficient construction. The bottle shall be annealed and shall be capable of withstanding a test by hydraulic pressure to twice its maximum working pressure.

(7) Every air receiver and air bottle provided in such a ship shall be fitted with means of access for purposes of inspection and shall be provided with efficient drains for the removal of oil and water, and with efficient relief valves to prevent overpressure. If the air receiver or air bottle can be isolated from the relief valve, it shall be fitted with one or more fusible plugs so as to discharge its contents in the event of fire.

(8) (a) Every air pressure pipe provided in such a ship and every fitting connected to such pipe, shall be capable of withstanding the maximum working stresses to which it may be subjected with a factor of safety which is adequate having regard to:

- (i) the material of which it is constructed; and
- (ii) the working conditions under which it is intended to be used.

(b) Without prejudice to the generality of the foregoing, every such pipe and fitting shall be capable of withstanding a test by hydraulic pressure to twice its maximum working pressure.

(c) Every such pipe shall be properly supported. Provision shall be made which will keep the interior of the pipe free from oil and either will prevent the passage of flame from the cylinders of the engine to the pipe, or will protect the pipe from the effects of an internal explosion.

(9) If, in any ship to which these Rules apply, an air pressure pipe may receive air from any source at a higher pressure than it can withstand with an adequate factor of safety, an efficient reducing valve, relief valve and pressure gauge shall be fitted to such pipe.

### *Engine Cooling Systems*

73. (1) In every ship to which these Rules apply, being a ship propelled by internal combustion machinery or provided with internal combustion engines for the maintenance of services essential for the safety of the ship or of persons on board, two pumps shall be provided each of which shall be capable of supplying adequate cooling water to such machinery or engines, as the case may be, and to any oil coolers or fresh water coolers fitted thereto. Provided that in ships of Classes III to VI(A), inclusive, only one such pump shall be required.

(2) If direct sea water cooling is used for any such machinery or engines, the sea water suction shall be provided with strainers which can be cleaned without interruption of the supply of water.

(3) Means shall be provided for ascertaining whether the cooling systems are working properly and for preventing overpressure in any part thereof.

(4) The exhaust pipes and silencers of every internal combustion engine provided in a ship to which these Rules apply shall be efficiently cooled or lagged.

#### *Lubricating Oil Systems*

74. (1) In every ship to which these Rules apply, being a ship in which oil for the lubrication of the main engines is circulated under pressure, at least two pumps shall be provided each of which shall be adequate for circulating such oil. Provided that in ships of Classes III to VI(A), inclusive, only one such pump shall be required.

(2) Strainers shall be provided for straining the lubricating oil, and, except in ships of Classes III to VI(A), inclusive, shall be capable of being cleaned without interrupting the supply of such oil.

(3) Means shall be provided for ascertaining whether the lubricating system is working properly, and for preventing overpressure in any part of the system. If the means of preventing overpressure is a relief valve it shall be in close circuit.

#### *Oil Fuel Installations: (Boilers and Machinery)*

75. (1) In every ship to which these Rules apply, being a ship propelled by means of oil-fired boilers or internal combustion machinery, every double bottom compartment appropriated for the storage of oil fuel, not being a compartment situated at the extreme forward or after end of the ship, shall be fitted with a watertight centre division.

(2) Every oil fuel tank in such a ship shall be properly constructed and shall be provided with save-alls or gutters which will catch any oil which may leak from the tank. No such tank shall be situated directly above boilers or other heated surfaces. Without prejudice to the generality of the foregoing, every such tank shall be capable of withstanding a test by hydraulic pressure in the case of a storage tank, settling tank or service tank, equal to that of a head of water one foot greater than the greatest head to which the tank may be subject when in service, but in the case of a settling tank, to not less than 15 lb. per square inch.

(3) The oil fuel carried in such a ship shall be effectively isolated from water ballast which may be carried therein. The pumping arrangements shall be such as will permit the oil fuel to be transferred from any storage tank or settling tank appropriated for oil fuel into any other storage tank or settling tank so appropriated. Provision shall be made to prevent the accidental discharge or overflow of oil overboard. If fresh water is stored in a tank adjacent to a tank appropriated for the storage of oil fuel a coffer dam shall be provided which will prevent contamination of the fresh water by the oil.

(4) In every such ship efficient means shall be provided for sounding every oil fuel tank therein and to prevent overpressure in such tank.

(5) In every such ship, an air pipe shall be led from every oil fuel tank to the open air, and the outlet thereof shall be in such a position that there will be no danger of fire or explosion resulting from the emergence of oil vapour from the pipe when the tank is being filled. Every such pipe shall be fitted with a detachable wire gauze diaphragm. If such pipe also serves as an overflow pipe provision shall be made which will prevent the overflow from running into or near a boiler room, galley or other place in which it might be ignited.

(6) Every drain provided in such a ship for the purpose of removing water from oil fuel in storage or settling tanks or in separators shall be of the self-closing type.

(7) The oil fuel filling stations in every such ship shall be isolated from other spaces in the ship and shall be efficiently drained and ventilated. Provision shall be made which will prevent overpressure in any oil-filling pipe lines.



(8) In every such ship, every oil pressure pipe shall be made of seamless steel, and, if used for conveying heated oil, shall be situated in a conspicuous position above the platforms in well-lighted parts of the boiler room or engine room. Every such pipe and joint therein and every fitting connected to such pipe, shall be capable of withstanding a test by hydraulic pressure to 400 lb. per square inch or to twice its maximum working pressure, whichever shall be the greater.

(9) In every such ship, every oil pipe, not being an oil pressure pipe, shall be made of steel and shall be led at such a height above the ship's inner bottom, if any, as will facilitate the inspection and repair of the pipe. Every such pipe and joint therein, and every fitting connected to such pipe, shall be capable of withstanding a test by hydraulic pressure to 50 lb. per square inch or to twice its maximum working pressure, whichever shall be the greater.

(10) In every such ship every steam heating pipe which may be in contact with oil shall be made of steel and, together with its joints, shall be capable of withstanding a test by hydraulic pressure to twice its maximum working pressure.

(11) In every such ship every suction pipe from any oil fuel tank situated above an inner bottom, and every oil fuel levelling pipe within a boiler room or engine room shall be fitted with a valve or cock secured to each tank to which the pipe is connected. Every such valve or cock fitted to an oil fuel suction pipe shall be so arranged that it may be closed both from the compartment in which it is situated and from a readily accessible position outside such compartment and not likely to be cut off in the event of fire in that compartment. Every such valve or cock fitted to an oil fuel levelling pipe shall be so arranged that it can be closed or opened from a readily accessible position above the bulkhead deck and not likely to be cut off by a fire in the compartment in which the pipe is situated. If any oil tank filling pipe is not connected to an oil fuel tank at or near the top of the tank, it shall be fitted with a non-return valve or with a valve or cock secured to the tank to which it is connected and so arranged that it may be closed both from the compartment in which it is situated and from a readily accessible position outside such compartment and not likely to be cut off in the event of fire in that compartment.

(12) In every such ship every master valve at the furnace fronts which controls the supply of oil fuel to sets of burners shall be of a quick-closing type, and fitted in a conspicuous position and readily accessible. Provision shall be made to prevent oil from being turned on to any burner unless such burner has been correctly coupled up to the oil supply line.

(13) In every such ship every valve used in connection with the oil fuel installation shall be so designed and constructed as to prevent the cover of the valve chest being slackened back or loosened when the valve is operated.

(14) In every such ship every pump provided for use in connection with the oil fuel system shall be separate from the ship's feed pumps, bilge pumps and ballast pumps and the connections of any of such pumps, and shall be provided with an efficient relief valve which shall be in close circuit. Provision shall be made by which every oil fuel pressure pump and transfer pump may be stopped from a position outside the compartment in which such pump is situated.

(15) Every such ship shall be provided with not less than two oil fuel units, each comprising a pressure pump, filters and a heater. Such pump, filters and heater shall be of efficient design and substantial construction. Provision shall be made which will prevent overpressure in any part of the oil fuel units. The parts of such oil fuel units which are subject to oil pressure, and the joints thereof, shall be capable of withstanding a test by hydraulic pressure to 400 lb. per square inch or twice their maximum working pressure, whichever shall be the greater. Any relief valves fitted to prevent overpressure in the oil fuel heater shall be in close circuit. If steam is used for heating oil fuel in bunkers, tanks, heaters or separators in any such ship, exhaust drains shall be provided to discharge the water of condensation into an observation tank.

(16) In every such ship save-alls or gutters shall be provided under every oil fuel pump, filter and heater to catch any oil which may leak or be spilled therefrom. Save-alls or gutters shall be provided in way of the furnace mouths to catch oil which may escape

from the burners. Provision shall be made which will prevent oil which may escape from any oil fuel pump, filter or heater from coming into contact with boilers or other heated surfaces.

(17) Every oil fuel separator in such a ship shall be of efficient design and substantial construction. Provision shall be made which will prevent overpressure in any part thereof, and which will prevent the discharge of oil vapour therefrom into confined spaces.

(18) If, in any ship to which these Rules apply, being a ship propelled by means of oil-fired boilers, dampers are fitted to the funnels or boilers, provision shall be made for securing the dampers in the open position, and an indicator shall be provided to show whether the dampers are open or shut.

(19) For the purposes of this Rule the expression "oil fuel tank" includes an oil fuel storage tank, an oil fuel settling tank, an oil fuel service tank and an oil fuel overflow tank.

#### *Oil Fuel Installations: (Cooking Ranges)*

76. (1) If, in any ship to which these Rules apply, a cooking range is supplied with fuel from an oil tank, the tank shall not be situated in a galley, and the supply of oil to the burners shall be capable of being controlled from a position outside the galley. No range or burners shall be fitted which are designed to be operated by means of oil fuel having a flash point of less than 150°F.

(2) The tank shall be provided with an air pipe leading to the open air. The pipe shall be in such a position that there will be no danger of fire or explosion resulting from the emergence of oil vapour from the pipe when the tank is being filled. The pipe shall be fitted with a detachable wire gauze diaphragm.

(3) Efficient means shall be provided for filling every such tank and for preventing overpressure therein.

#### *Ventilation*

77. In every ship to which these Rules apply, every space in which an oil fuel tank or any part of an oil fuel installation is situated shall be adequately ventilated.

#### *Steering Gear*

78. (1) Every ship to which these Rules apply shall be provided with efficient main and auxiliary steering gear. Provided that auxiliary steering gear shall not be required if the ship's main steering gear is fitted with duplicate power units and duplicate connections up to the rudder stock.

(2) The auxiliary steering gear shall be capable of being rapidly brought into action and shall be of adequate strength, and of sufficient power to enable the ship to be steered at a navigable speed. The auxiliary steering gear shall be operated by power in any such ship which is fitted with a rudder stock of over 9 inches in diameter in way of the tiller.

(3) In every ship to which these Rules apply means shall be provided by which the ship can be steered from a position aft.

#### *Stores, Spare Gear and Tools*

79. Every ship of Classes I, II and II(A) shall be provided with such stores, spare gear and tools as are sufficient, having regard to the intended service of the ship, to enable running repairs to the ship's boilers and machinery to be made while the ship is at sea.

## PART VII

### MISCELLANEOUS

#### *Application of Part VII*

80. This Part of these Rules applies to every ship to which these Rules apply.

#### *Compasses*

81. (1) (a) Every ship of Class I shall be provided with three efficient magnetic compasses which shall be sited on the ship's centre line. One of such compasses shall be provided for use as a steering compass and shall be sited at the normal steering position, and another shall be provided for use as a standard compass and shall be sited near to the normal steering position and in a position from which the view of the horizon is least obstructed. A third such compass shall be provided at the after steering position, and shall, together with its gimbal units, be interchangeable with the steering compass.

Provided that a magnetic steering compass shall not be required if

- (i) the standard compass is of the reflector or projector type and is equipped with a device by which it may be read from the normal steering position;
- (ii) the standard compass is interchangeable with the after steering compass; and
- (iii) a card of a gyroscopic compass or of a repeater thereof can be read from the normal steering position.

(b) Every magnetic compass provided in such a ship shall be mounted on a binnacle. Provided that the after steering compass may be mounted on a pedestal.

(2) Every ship of Classes II, II(A) and III shall be provided with two efficient magnetic compasses sited on the ship's centre line, one of which shall be for use as a steering compass and shall be sited at the normal steering position, and the other of which shall be for use as a standard compass, and shall be sited near to the normal steering position and in a position from which the view of the horizon is least obstructed. Each of such compasses shall be mounted on a binnacle.

(3) Every ship of Classes IV, VI and VI(A) shall be provided with one efficient magnetic compass which shall be readily available at the normal steering position.

#### *Depth-Sounding Devices*

82. (1) Every ship of Classes I, II and II(A) shall be provided with an efficient mechanical depth-sounding device operated by means of a line, and with such spare parts as are sufficient, having regard to the type of the device and to the intended service of the ship, to enable the device to be maintained in working order while the ship is at sea. Provided that a mechanical depth-sounding device shall not be required in any ship of Class II or II(A) which is under 1,600 tons.

(2) Every ship of Classes I to III, inclusive, shall be provided with two hand lead-lines, each at least 25 fathoms long, and each with a lead weighing at least 7 lbs.

#### *Anchors and Chain Cables*

83. Every ship to which these Rules apply shall be provided with such anchors and chain cables as are sufficient in number, weight and strength, having regard to the size and intended service of the ship.

#### *Hawsers and Warps*

84. Every ship to which these Rules apply shall be provided with such hawsers and warps as are sufficient in number and strength, having regard to the size and intended service of the ship.

#### *Means of Escape*

85. (1) Every ship to which these Rules apply, not being an open or partially-decked ship of Classes V, VI or VI(A), shall be provided with such doorways, stairways, ladderways and other means of escape as will provide readily accessible means of



escape for all persons in the ship. The means of escape shall be so designed and constructed as to be capable of being easily used by the persons for whom they are intended. The number and width of such means of escape shall be sufficient, having regard to the number of persons by whom they may be used and shall not pass through any doorway which may be closed by a door required by these Rules to be watertight.

(2) In every ship of Classes I, II and II(A) at least two such means of escape shall be provided in each portion of a between decks above the bulkhead deck falling within a main vertical zone, and one of the means of escape provided in each such portion shall give access to a stairway leading upwards from the between decks. Provided that in ships of Class I the means of escape from the lifeboat embarkation deck shall not be required to give access to a stairway leading upwards from that deck.

(3) In every ship of Class I such means of escape shall lead to the lifeboat embarkation deck.

(4) In every ship of Classes II and II(A) such means of escape shall lead to the lifeboat embarkation deck and to an open deck of sufficient area, having regard to the number of persons whom the ship may carry.

(5) In every ship of Classes III to VI (A), inclusive, not being an open or partially-decked ship of Classes V, VI or VI(A), such means of escape shall lead to an open deck of sufficient area, having regard to the number of persons whom the ship may carry.

(6) Every ship of Classes V, VI and VI(A), being an open or partially-decked ship, shall be provided with readily accessible means of escape from all enclosed spaces in the ship. Such means of escape shall be sufficient in number and width, having regard to the number of persons who may be in the said spaces.

#### *Guard Rails, Stanchions and Bulwarks*

86. (1) In every ship to which these Rules apply, bulwarks or guard rails shall be provided on every deck to which any persons may have access. Such bulwarks or guard rails, together with stanchions supporting the guard rails, shall be so placed, designed and constructed, and in particular shall be of such a height above the deck, as to prevent any person who may have access to that deck from accidentally falling therefrom. Any freeing ports fitted in such a bulwark shall be covered by a grid or bars which will prevent any person from falling through the port.

(2) In every open or partially-decked ship of Classes V, VI or VI(A), every washstrake, covering board and coaming shall be so placed, designed and constructed and in particular shall be of such a height above the floorboards, as to prevent any person from accidentally falling overboard.

#### *Alternative Construction, Equipments and Machinery*

87. Where these Rules require that the hull or machinery of a ship shall be constructed in a particular manner, or that particular equipment shall be provided, or particular provision shall be made, the Minister may allow the hull or machinery of the ship to be constructed in any other manner, or any other equipment to be provided or other provision made, if he is satisfied that that other construction or equipment, or other provision, is at least as effective as that required by these Rules.

Given under the Official Seal of the Minister of Transport this eleventh day of November, 1952.

(L.S.)

*Gilmour Jenkins,*  
Secretary of the Ministry of Transport.

FIRST SCHEDULE

LIMITS OF SMOOTH WATER AND PARTIALLY SMOOTH WATER AREAS

District	Smooth Water Areas	Partially Smooth Water Areas*†
Cromarty	In Cromarty Firth but not below Cromarty.	Within a line from North Sutor to Nairn.
Inverness	Within a line from Fort George to Chanonry Point to Fort William.	Within a line from North Sutor to Nairn.
Aberdeen	Within a line from South Jetty to Abercromby Jetty.	No partially smooth waters.
Dundee	Within a line from Fish Dock, Dundee to Craig Head, East Newport.	Within a line from Broughty Castle to Tayport.
Queensferry	Above the Forth Bridge	Within a line from Kirkcaldy to Portobello.
Leith	Inside the Breakwaters	Within a line from Kirkcaldy to Portobello.
Lerwick	—	In winter, within a line from Point of Scotland to Heogan to the northward and from Holm of Mel to the lighthouse situated some 3 cables to the eastward of the Nabb to the southward. In summer, within a line from Easter Rova Head to Score Head to the northward and from the south end of Ness of Sound to Kirkabisterness to the Southward.
Kirkwall	—	Between Kirkwall and Rousay.
Stromness	—	To Scapa but not outside Scapa Flow.
Berwick-on-Tweed	Within a line from Spittal Point to the inner end of Breakwaters.	No partially smooth waters.
Amble	Inside the Breakwaters	No partially smooth waters.
Blyth	Inside the Pier Heads	No partially smooth waters.
Newcastle, North and South Shields.	Inside the Tyne Pier Heads	No partially smooth waters.
Sunderland	Inside the Sunderland Pier Heads	No partially smooth waters.
Hartlepool, East	Inside the Breakwaters	No partially smooth waters.
Stockton, Middlesbrough.	Above No. 8 Beacon	No partially smooth waters.
Whitby	Inside the Whitby Pier Heads	No partially smooth waters.
Hull	—	In winter, within a line from New Holland to Paull. In summer, within a line from Cleethorpes Pier to Patrington Church
Goole, Gainsborough, Lincoln, Nottingham, York.	Within a line from North Ferriby to South Ferriby.	In winter, within a line from New Holland to Paull. In summer, within a line from Cleethorpes Pier to Patrington Church.

\* The outer limits of the smooth water areas specified in the second column of this Schedule shall be taken to be the corresponding inner limits of the partially smooth water areas specified in the third column of this Schedule.

† Unless otherwise indicated these limits apply at all times of the year. In this Schedule "summer" means the months of April to October, inclusive, and "winter" means the months of November to March, inclusive.

District	Smooth Water Areas	Partially Smooth Water Areas*†
Grimsby	—	In winter, no partially smooth waters. In summer, within a line from Cleethorpes Pier to Patrington Church.
Boston	Inside the New Cut	No partially smooth waters.
Wisbech	Inside Wisbech Cut	No partially smooth waters.
King's Lynn	Inside Lynn Cut	No partially smooth waters.
Yarmouth and Lowestoft	On all inland navigation inside the Harbour Entrances at Yarmouth or Lowestoft.	No partially smooth waters.
Harwich, Ipswich, or Felixstowe Railway Pier.	On the River Orwell or on the River Stour and within a line from Dovercourt Breakwater to Landguard Point.	No partially smooth waters.
Woodbridge	On the River Deben to the Mouth	No partially smooth waters.
Maldon	On the River Blackwater within a line from West Mersea Point to Bradwell Point	In summer, within a line from Clacton Pier to Reculvers. In winter, within a line from Colne Point to Whitstable.
Burnham-on-Crouch	On the River Crouch within a line from Hollywell Point to Foulness Point.	In summer, within a line from Clacton Pier to Reculvers. In winter, within a line from Colne Point to Whitstable.
London	Above Gravesend	In summer, within a line from Clacton Pier to Reculvers. In winter, within a line from Colne Point to Whitstable.
Rochester	Sheerness and Whitstable inside Sheppey.	In summer, within a line from Clacton Pier to Reculvers. In winter, within a line from Colne Point to Whitstable.
Dover	Within a line drawn across the East and West Entrances to the Harbour.	No partially smooth waters.
Littlehampton	On the River Arun above Littlehampton Pier.	No partially smooth waters.
Chichester.	Not seaward of a line drawn between Eastoke Point and West Wittering (Tower).	No partially smooth waters.
Langston Harbour	Not seaward of a line drawn between Eastney Point and Gunner Point.	Inside the Isle of Wight within an area bounded by a line drawn between Gunner Point and Trinity Church, Bembridge, to the eastward and the Needles and Hurst Point to the westward.
Portsmouth	Within Portsmouth Harbour	Inside the Isle of Wight within an area bounded by a line drawn between Gunner Point and Trinity Church, Bembridge, to the eastward and The Needles and Hurst Point to the westward.
Southampton	Within a line from Calshot Castle to Hook Beacon.	Inside the Isle of Wight within an area bounded by a line drawn between Gunner Point and Trinity Church, Bembridge, to the eastward and The Needles and Hurst Point to the westward.

\* The outer limits of the smooth water areas specified in the second column of this Schedule shall be taken to be the corresponding inner limits of the partially smooth water areas specified in the third column of this Schedule.

† Unless otherwise indicated these limits apply at all times of the year. In this Schedule "summer" means the months of April to October, inclusive, and "winter" means the months of November to March, inclusive.



District	Smooth Water Areas	Partially Smooth Water Areas*†
Cowes	Between East and West Cowes within the River Medina.	Inside the Isle of Wight within an area bounded by a line drawn between Gunner Point and Trinity Church, Bembridge, to the eastward and The Needles and Hurst Point to the Westward.
Christchurch	Within Christchurch Harbour excluding the Run.	No partially smooth waters.
Poole	Inside the Harbour not seaward of the line of the Chain Ferry between Sandbanks and S. Haven Point.	No partially smooth waters.
Weymouth	—	Within Portland Harbour and between River Wey and Portland Harbour.
Exeter	Within a line from Warren Point to the Coastguard Flag Staff at Exmouth.	No partially smooth waters.
Teignmouth	Within the Harbour	No partially smooth waters.
Dartmouth	River Dart within a line from Kettle Point to Battery Point.	No partially smooth waters.
Salcombe and Kingsbridge	River Salcombe not seaward of a line Sandhill Point to Biddlehead.	No partially smooth waters.
Plymouth	Within a line from the inside of Drakes Island to Mount Batten Pier. The River Yealm within a line from Warren Point to Misery Point.	Within a line from Cawsand to the Breakwater and the Breakwater to Staddon Pier.
Fowey	Inside the Harbour	No partially smooth waters.
Falmouth	Within a line from St. Anthony Head to Pendennis Point.	In winter, no partially smooth waters. In summer, with a line from St. Anthony Head to Nare Point.
Padstow	Padstow Harbour, within a line from Gun Point to Brae Hill.	Within a line from Stepper Point to Trebetherick Point.
Barnstaple	Within the Bar	No partially smooth waters.
Bridgwater	Inside Stert Point	Within the Bar.
Bristol	Within a line from Avonmouth Pier to Wharf Point.	In winter, within a line from Blackmore Point to Portskewet. In summer, within a line from Barry Dock Pier to Steephelm, thence to Brean Down. Winter and summer, inner limit not above No. 1 beacon at the southern entrance to "The Shoots".
Gloucester	River Severn or Avon to Sharpness Point via Gloucester Canal.	No partially smooth waters.
Chepstow	River Wye, above Chepstow	No partially smooth waters.

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District	Smooth Water Areas	Partially Smooth Water Areas*†
Cardiff	Within a line from Low Water Pier Head to the Lifeboat House near Penarth Dock entrance.	In winter, no partially smooth waters. In summer, within a line from Barry Dock Pier to Steepholt, thence to Brean Down. Winter and summer, inner limit, not above No. 1 beacon at the southern entrance to "The Shoots".
Barry Dock	Inside the Dock	In winter, no partially smooth waters. In summer, within a line from Barry Dock Pier to Steepholt, thence to Brean Down. Winter and summer, inner limit, not above No. 1 beacon at the southern entrance to "The Shoots".
Neath Swansea Llanelli and Burry Port.	Inside the Bar Inside the Dock Outer limit, on a line Burry Port Western Pier to Whiteford Point; Inner limit, Lougher Railway Bridge.	No partially smooth waters. No partially smooth waters. No partially smooth waters.
Milford	Within a line from South Hook Point to Thorn Point.	No partially smooth waters.
Cardigan Barmouth	Inside the Bar Within a line from Barmouth Pier to Penrhyn Point.	No partially smooth waters. No partially smooth waters.
Aberdovey	Within a line from Aberdovey Station to Trwyn Bach.	No partially smooth waters.
Portmadoc Holyhead Caernarvon, Bangor	Inside the Bar Buoy Inside the Breakwater Within the Menai Straits to Aber Menai or Beaumaris.	No partially smooth waters. No partially smooth waters. Within the Menai Straits from Caernarvon Bar to Puffin Island.
Conway	Within a line from Mussel Hill to Tremlyd Point.	No partially smooth waters.
Chester	River Dee, not below Connah's Quay.	Inside the West Hoyle Bank.
Liverpool	Above the Rock Light House	In winter, no partially smooth waters. In summer, within a line from Formby Point to Hilbre Point.
Preston	Within a line from Lytham to Southport.	Within a line from Southport to Blackpool inside the Banks.
Fleetwood	Within a line from Low Light to Knott End Pier.	In winter, no partially smooth waters. In summer, within a line from Rossall Point to Humphrey Head.
Lancaster	Within a line from Sunderland Point to Chapel Point.	In winter, no partially smooth waters. In summer, within a line from Rossall Point to Humphrey Head.
Heysham		In winter, no partially smooth waters. In summer, within a line from Rossall Point to Humphrey Head.

\* The outer limits of the smooth water areas specified in the second column of this Schedule shall be taken to be the corresponding inner limits of the partially smooth water areas specified in the third column of this Schedule.

† Unless otherwise indicated these limits apply at all times of the year. In this Schedule "summer" means the months of April to October, inclusive, and "winter" means the months of November to March, inclusive.

District	Smooth Water Areas	Partially Smooth Water Areas* †
Morecambe	On the Kendal/Preston Canal	In winter, no partially smooth waters. In summer, within a line from Rossal Point to Humphrey Head.
Barrow	Between Walney Island and the Mainland	No partially smooth waters.
Douglas	From Battery Pier to Victoria Pier.	No partially smooth waters.
Carlisle	Above Port Carlisle	Within a line from Southernness to Silloth.
Dumfries	Inside Aird Point and Glenhaven Point.	Within a line Southernness to Silloth.
Stranraer	Within a line from Cairn Ryan to Kirkcolm Point	Loch Ryan, within a line from Finnart's Point to Milleur Point.
Ayr	Inside the Bar	No partially smooth waters.
Glasgow	Above partially smooth waters	<i>Outer limit:</i> a line from Skipness to Farland Head round Garroch Head. <i>Inner limit:</i> In winter, a line from Cloch Lighthouse to Dunoon Pier. In summer, a line from Bogany Point, Isle of Bute to Skelmorlie Castle and Ardlamont Point inside the Kyles of Bute, extended between 5th June and 5th September, both dates inclusive, by a line from a point two miles off the Ayrshire Coast at Skelmorlie Castle to Tormont End, Cumbrae, and a line from Millport round Farland Point to Fairlie Pier.
Campbeltown	Inside the Harbour but not outside Davarr Island.	No partially smooth waters.
Oban	—	Inside the Island of Kerrera and to Dunstaffnage.
Ballachulish	Within Loch Leven and not outside Peter Straits.	No partially smooth waters.
Fort William	Loch Linnhe but not south of Keppanach. Loch Eil and on the Canal to Inverness.	No partially smooth waters.
Kyle of Lochalsh	Between Kyle of Lochalsh and Kyleakin on the Isle of Skye.	Through Loch Alsh to the Head of Loch Duich.
Belfast	Within a line from Holywood to Macdon Point.	In winter, no partially smooth waters. In summer, within a line from Carrickfergus to Bangor.
Carlingford Lough	Within a line from Greenore to Greencastle Point.	No partially smooth waters.
Larne	Within a line from Larne Pier to the Ferry Pier on Island Magee.	No partially smooth waters.
Lough Erne	Upper or Lower Lough Erne	No partially smooth waters.
Lough Neagh	Within 2 miles of the shore	At a greater distance than 2 miles from the shore.
Londonderry	Within a line from Magilligan Point to Greencastle.	No partially smooth waters.

\* The outer limits of the smooth water areas specified in the second column of this Schedule shall be taken to be the corresponding inner limits of the partially smooth water areas specified in the third column of this Schedule.

† Unless otherwise indicated these limits apply at all times of the year. In this Schedule "summer" means the months of April to October, inclusive, and "winter" means the months of November to March, inclusive.



## CALCULATION OF MAXIMUM LENGTH OF WATERTIGHT COMPARTMENTS

### PART I

#### 1. General

- (1) For the purposes of this Schedule, except where otherwise specified,
- (a) all linear measurements shall be in feet; and
  - (b) all volumes shall be in cubic feet and shall be calculated from measurements taken to moulded lines.
- (2) In this Schedule the symbol "L" denotes the length of the ship.
- (3) In this Schedule the expression "passenger spaces" shall include galleys, laundries and other similar spaces provided for the service of passengers, in addition to space provided for the use of passengers.

#### 2. Permissible Length

Subject to the provisions of paragraph 6 of this Schedule the length of a compartment shall not exceed its permissible length. The permissible length of a compartment having its centre at any point shall be the product of the floodable length at that point and the factor of subdivision of the ship.

### PART II

#### SHIPS OF CLASSES I, II AND II(A), OTHER THAN SHIPS TO WHICH PART III OF THIS SCHEDULE APPLIES

#### 3. Assumptions of Permeability

The assumptions of permeability which shall be taken into account in determining the floodable length at any point in ships to which this Part of this Schedule applies shall be as follows:

##### (a) Machinery space:

- (i) In the case of ships not propelled by internal combustion engines the assumed average permeability throughout the machinery space shall be determined by the following formula:

$$80 + 12.5 \frac{(a - c)}{v} \text{ where}$$

$a$  = volume of the passenger spaces and crew spaces below the margin line within the limits of the machinery space;

$c$  = volume of the between deck spaces below the margin line within the limits of the machinery space which are appropriated to cargo, coal or stores; and

$v$  = volume of the machinery space below the margin line.

- (ii) In the case of ships propelled by internal combustion engines the average permeability throughout the machinery space shall be taken as 5 greater than that given by the aforesaid formula.
- (iii) In any case in which the average permeability throughout the machinery space, as determined by detailed calculation, is less than that given by the aforesaid formula, the calculated value may be substituted. For the purposes of such calculation, the permeability of passenger spaces and crew spaces shall be taken to be 95, that of all spaces appropriated for cargo, coal or stores shall be taken to be 60, and that of double bottom, oil fuel and other tanks forming part of the structure of the ship shall be taken to be 95 or such lesser figure as the Minister may approve in the case of that ship.

(b) Portions before and abaft the machinery space:

(i) the assumed average permeability throughout the portions of the ship before and abaft the machinery space shall be determined:

(a) by the following formula:

$$63 + 35 \frac{a}{v} \text{ where}$$

$a$  = volume of the passenger spaces and crew spaces which are situated below the margin line before or abaft the machinery space, as the case may be, and

$v$  = volume of the portion of the ship below the margin line before or abaft the machinery space, as the case may be; or

(b) if the Minister so determines in the case of any ship at any time not later than 40 days after a Surveyor of Ships has received a plan of the ship showing the watertight subdivision thereof, by detailed calculation for the purpose of which the permeability of spaces shall be assumed to be as follows:

passenger spaces . . . . .	95
crew spaces . . . . .	95
spaces appropriated to machinery . . . . .	80
spaces appropriated to cargo, coal, stores or baggage rooms . . . . .	60
tanks forming part of the structure of the ship and double bottoms . . . . .	95, or such lesser figure as the Minister may permit in the case of any ship.

(ii) For the purposes of this paragraph a space within a passenger space or crew space shall be deemed to be a part thereof unless it is appropriated for other purposes and is enclosed by permanent steel bulkheads.

#### 4. Factor of Subdivision

(1) Subject to the provisions of sub-paragraph (4) of this paragraph, in the case of ships the length of which is 430 feet or more, the factor of subdivision  $F$  shall be determined by the following formula:

$$F = A - \frac{(A - B)(C_s - 23)}{100}$$

where  $A$  and  $B$  are respectively determined in accordance with the provisions of sub-paragraph (5) of this paragraph and  $C_s$  is the criterion numeral determined in accordance with the provisions of paragraph 5 of this schedule. Provided that where in the case of any ship the factor  $F$  is less than .4 and the Minister is satisfied that it is impracticable to apply the factor  $F$  in determining the permissible length of a compartment appropriated for machinery, the Minister may allow an increased factor not exceeding .4 to be applied to that compartment.

(2) Subject to the provisions of sub-paragraph (4) of this paragraph, in the case of ships the length of which is less than 430 feet but not less than 260 feet having a criterion numeral of not less than

$$\frac{4691 - 10L}{17}$$

(hereinafter in this paragraph referred to as  $S$ ), the factor of subdivision  $F$  shall be determined by the following formula:

$$F = 1 - \frac{(1 - B)(C_s - S)}{123 - S}$$

where  $B$  is the factor determined in accordance with the provisions of sub-paragraph (5) of this paragraph and  $C_s$  is the criterion numeral determined in accordance with the provisions of paragraph 5 of this Schedule.

(3) In the case of ships the length of which is less than 430 feet but not less than 260 feet and having a criterion numeral less than  $S$  or in the case of ships the length of which is less than 260 feet the factor of subdivision shall be unity.

(4) In the case of a ship of any length which is intended to carry a number of passengers exceeding 12 but not exceeding

$$\frac{L^2}{7000} \text{ or } 50$$

whichever is the lower, the factor of subdivision shall be determined in the manner provided in sub-paragraph (3) of this paragraph.

(5) For the purposes of this paragraph the factors A and B shall be determined by the following formulae:

$$A = \frac{190}{L - 198} + \cdot 18 \text{ (where } L = 430 \text{ and upwards)}$$

$$B = \frac{100}{L - 138} + \cdot 18 \text{ (where } L = 260 \text{ and upwards)}$$

### 5. Criterion of Service

The criterion numeral for ships to which this Part of this Schedule applies shall be determined by the following formulae:

when  $P_i$  is greater than P

$$C_s = 72 \frac{M + 2P_i}{V + P_i - P}$$

and in all other cases

$$C_s = 72 \frac{M + 2P}{V}$$

where:

$C_s$  = the criterion numeral;

M = the volume of the machinery space, with the addition thereto of the volume of any permanent oil fuel bunkers which may be situated above the inner bottom and before or abaft the machinery space;

P = the volume of the passenger spaces and crew spaces below the margin line;

V = the volume of the ship below the margin line;

N = number of passengers which the ship is intended to carry;  
and

$$P_i = \cdot 6LN$$

Provided that:

(a) where the value of  $\cdot 6LN$  is greater than the sum of P and the whole volume of the passenger spaces above the margin line, the figure to be taken as  $P_i$  shall be that sum or  $\cdot 4LN$  whichever is the greater;

(b) values of  $C_s$  less than 23 shall be taken as 23; and

(c) values of  $C_s$  greater than 123 shall be taken as 123.

### 6. Special Rules for Subdivision

(1) Compartments exceeding the permissible length:

(a) A compartment may exceed its permissible length provided that the combined length of each pair of adjacent compartments to which the compartment in question is common does not exceed either the floodable length or twice the permissible length, whichever is the less.

(b) If one compartment of either of such pairs of adjacent compartments is situated inside the machinery space, and the other compartment thereof is situated outside the machinery space, the combined length of the two compartments shall be adjusted in accordance with the mean average permeability of the two portions of the ship in which the compartments are situated.

(c) Where the lengths of two adjacent compartments are governed by different factors of subdivision, the combined length of the two compartments shall be determined proportionately.



(d) Where in any portion of a ship bulkheads required by these Rules to be watertight are carried to a higher deck than in the remainder of the ship, separate margin lines may be used for calculating the floodable length of that portion of the ship, if:

(i) the two compartments adjacent to the resulting step in the bulkhead deck are each within the permissible length corresponding to their respective margin lines and, in addition, their combined length does not exceed twice the permissible length determined by reference to the lower margin line of such compartments;

(ii) the sides of the ship are extended throughout the ship's length to the deck corresponding to the uppermost margin line and all openings in the shell plating below that deck throughout the length of the ship comply with the requirements of Rule 15 of these Rules as if they were openings below the margin line.

**(2) Additional subdivision at forward end:**

In ships 430 feet in length and upwards, the watertight bulkhead next abaft the collision bulkhead shall be fitted at a distance from the forward perpendicular which is not greater than the permissible length appropriate to a compartment bounded by the forward perpendicular and such bulkhead.

**(3) Steps in bulkheads:**

If a bulkhead required by these Rules to be watertight is stepped it shall comply with one of the following conditions:

(i) In ships having a factor of subdivision not greater than  $\cdot 9$ , the combined length of the two compartments separated by such bulkhead shall not exceed 90 per cent. of the floodable length or twice the permissible length whichever is the less. In ships having a factor of subdivision greater than  $\cdot 9$ , the combined length of the two compartments shall not exceed the permissible length.

(ii) Additional subdivision is provided in way of the step to maintain the same measure of safety as that secured by a plane bulkhead; or

(iii) The compartment over which the step extends does not exceed the permissible length corresponding to a margin line taken 3 inches below the step.

**(4) Recesses in bulkheads:**

If any part of a recess lies outside vertical surfaces on both sides of the ship situated at a distance from the shell plating equal to one-fifth of the breadth of the ship and measured at right angles to the centre line at the level of the deepest subdivision load water line, the whole of such recess shall be deemed to be a step in a bulkhead for the purposes of sub-paragraph (3) of this paragraph.

**(5) Equivalent plane bulkheads:**

Where a bulkhead required by these Rules to be watertight is recessed or stepped an equivalent plane bulkhead shall be assumed in determining the subdivision.

**(6) Minimum spacing of bulkheads:**

If the distance between two adjacent bulkheads required by these Rules to be watertight, or their equivalent plane bulkheads, or the distance between transverse planes passing through the nearest stepped portions of the bulkheads, is less than  $\cdot 03L + 10$  feet, or 35 feet, or  $\cdot 1L$ , whichever is the least, only one of those bulkheads shall be regarded as forming part of the subdivision of the ship.

**(7) Allowance for local subdivision:**

Where in any ship a main transverse watertight compartment contains local subdivision and the Minister is satisfied that, after any assumed side damage extending over a length of  $\cdot 03L + 10$  feet, or 35 feet, or  $\cdot 1L$ , whichever is the least, the whole volume of the main compartment will not be flooded, a proportionate allowance may be made in the permissible length otherwise required for such compartment. In such a case the volume of effective buoyancy assumed on the undamaged side shall not be greater than that assumed on the damaged side.

### PART III

SHIPS OF CLASSES II AND II(A) WHICH ARE PERMITTED BY THE MINISTER, IN EXERCISE OF HIS POWER UNDER PARAGRAPH (5) OF RULE 5 OF THE MERCHANT SHIPPING (LIFE-SAVING APPLIANCES) RULES 1952,(f) TO CARRY PERSONS IN EXCESS OF THE LIFEBOAT CAPACITY PROVIDED ON BOARD

#### 7. General Rules for Subdivision

Subject to the modifications set forth in this Part of this Schedule the maximum length of compartments in ships to which this Part of this Schedule applies shall be determined as if they were ships to which Part II of this Schedule applies.

#### 8. Assumption of Permeability in Portions before and abaft the Machinery Space

In ships to which this Part of this Schedule applies the assumed average permeability throughout the portions of the ship before and abaft the machinery space shall be determined

(a) by the following formula:

$$95 - 35 \frac{b}{v} \text{ where}$$

$b$  = the volume of the spaces which are situated below the margin line before or abaft the machinery space, as the case may be, and above the tops of floors, inner bottom, or peak tanks, and which are appropriated for use as coal or oil fuel bunkers, store rooms, baggage rooms, mail rooms, chain lockers or fresh water tanks and of spaces appropriated for cargo if the Minister is satisfied the greater part of the volume of the space is intended to be occupied by cargo; and

$v$  = the volume of the portion of the ship below the margin line before or abaft the machinery space, as the case may be; or

(b) if the Minister so determines in the case of any ship at any time not later than 40 days after a Surveyor of Ships has received a plan of the ship showing the watertight subdivision thereof, by detailed calculation for the purpose of which the permeability of spaces shall be assumed to be as follows:

passenger spaces	95
crew spaces	95
spaces appropriated to machinery	80
spaces appropriated to bunker coal, stores or baggage rooms	60
spaces appropriated to cargo, tanks forming part of the structure of the ship and double bottoms	95, or such lesser figure as the Minister may permit in the case of any ship.

#### 9. Factor of Subdivision

(1) Subject to the provisions of this paragraph, the factor of subdivision of ships to which this Part of this Schedule applies shall be the factor determined in the manner provided in paragraph 4 of this Schedule, or .5 whichever is the less. Provided that if the Minister is satisfied in the case of any ship the length of which is less than 300 feet that it is impracticable to apply that factor to any compartment, he may allow a higher factor to be applied to that compartment.

(2) If in the case of any ship to which this Part of this Schedule applies the Minister is satisfied that the quantity of cargo to be carried in the ship will be such as to render impracticable the application abaft the collision bulkhead of a factor of subdivision not exceeding .5, the factor of subdivision of the ship shall be determined as follows:

(a) in the case of ships the length of which is 430 feet and upwards, by the formula:

$$P = A - \frac{(A - BB)(C - 23)}{100}$$

(f) S.I. 1952/1949.

(b) in the case of ships the length of which is less than 430 feet but not less than 180 feet, and having a criterion numeral not less than  $S_1$ , by the formula:

$$F = 1 - \frac{(1 - BB)(C_s - S_1)}{123 - S_1}$$

For the purposes of the above formulae:

$$A = \frac{190}{L - 198} + .18 \text{ (where } L = 430 \text{ and upwards)}$$

$$BB = \frac{57.6}{L - 108} + .20 \text{ (where } L = 180 \text{ and upwards)}$$

$$S_1 = \frac{1950 - 4L}{10}$$

$C_s$  = the criterion numeral determined in accordance with paragraph 5 of this Schedule where  $P_1$  has the following values:

(a)  $.6LN$  or  $125N$  whichever is the greater for berthed passengers.

(b)  $125N$  for unberthed passengers.

(c) in the case of ships the length of which is less than 430 feet but not less than 180 feet and having a criterion numeral less than  $S_1$ , and of all ships the length of which is less than 180 feet, the factor of subdivision shall be unity.

#### PART IV

##### SHIPS OF CLASSES III TO VI INCLUSIVE

#### 10. General Rules for Subdivision

Subject to the modifications set forth in this Part of this Schedule the maximum length of compartments in ships to which this Part of this Schedule applies shall be determined as if they were ships to which Part II of this Schedule applies.

#### 11. Assumptions of Permeability

In ships to which this Part of this Schedule applies, the assumed average permeability shall be as follows:

(a) of the machinery space

(i) in ships propelled by internal combustion engines . . . . . 85

(ii) in all other ships . . . . . 80

(b) of spaces other than the machinery space . . . . . 95

#### 12. Factor of Subdivision

The factor of subdivision of ships to which this Part of this Schedule applies shall be as follows:

<i>Length of Ship in feet</i>	<i>Factor of Subdivision</i>
Over 350 . . . . .	.5
Over 300 but not over 350	.5 for compartments in machinery space and forward thereof. Unity for all other compartments.
Over 250 but not over 300	.5 for compartments forward of machinery space. Unity for all other compartments.
Over 200 but not over 250	Unity for combined forepeak and adjacent compartment, and for each other compartment.
200 and under . . . . .	Unity.



## STABILITY IN DAMAGED CONDITION

1. *Calculations of Stability in Damaged Condition*

The sufficiency of intact stability of every ship to which Part II of these Rules applies shall be determined by calculation which has regard to the design and construction of the ship and the damaged compartments, and which is in accordance with the following assumptions:

- (a) the ship shall be assumed to be in the worst condition as regards stability which is likely to be experienced having regard to the intended service of the ship;
- (b) the volume permeabilities and surface permeabilities shall be assumed to be as follows:

<i>Spaces</i>	<i>Permeability</i>
Appropriated to cargo, coal or stores.	60
Appropriated to accommodation for passengers and crew	95
Appropriated to machinery	85
Appropriated to liquids	0 or 95, whichever results in the more onerous requirements.

- (c) The minimum extent of damage shall be assumed to be as follows:

- (i) Longitudinal extent . 10 feet plus 3 per cent. of the length of the ship, or 35 feet, or 10 per cent. of the length of the ship, whichever is the least.
- (ii) Transverse extent . 20 per cent. of the breadth of the ship.  
(measured inboard from the ship's side at right angles to the centre line at the level of the deepest subdivision load water line.)
- (iii) Vertical extent . from the top of the double bottom up to the margin line.
- (iv) If any damage of lesser extent than that indicated in the foregoing subparagraphs (i), (ii) and (iii) would result in a more severe condition regarding heel or loss of metacentric height, such damage shall be assumed for the purposes of the calculation.

- (d) Where the ship is fitted with decks, inner skins or longitudinal bulkheads of sufficient tightness to restrict the flow of water, regard shall be had to such restrictions in the calculation.

2. *Sufficiency of Stability in Damaged Condition*

The intact stability of the ship shall be deemed to be sufficient if the aforesaid calculation shows that, after the assumed damage and after equalisation measures have been taken, the final condition of the ship is as follows:

- (i) in the event of symmetrical flooding the metacentric height is positive;
- (ii) in the event of unsymmetrical flooding the heel does not exceed seven degrees;
- (iii) in the event of unsymmetrical flooding the margin line is not submerged.

## CONSTRUCTION OF WATERTIGHT BULKHEADS, ETC.

## PART I

## SHIPS OF CLASS I

1. *Strength and Construction*

(1) Every bulkhead and other portion of the internal structure forming part of the watertight subdivision of the ship shall be of such strength and so constructed as to be capable of supporting, with an adequate margin of resistance, the pressure due to a head of water up to the margin line.

(2) Every such bulkhead and portion shall be constructed of mild steel and, if of riveted construction, shall comply with the requirements of paragraphs 2 to 6 inclusive of this Schedule, and if of welded construction shall not be of less strength, stiffness or efficiency than if it had been riveted and had complied with such requirements.

2. *Bulkheads*

(1) Every bulkhead required by these Rules to be watertight shall be constructed with plating of thickness not less than those indicated in Table 1 of Part IV of this Schedule. If a bulkhead is at the end of a stokehold space in a coal burning ship, the lower part of the bulkhead plating to a height of at least 24 inches above the stokehold floor shall be at least  $\cdot 1$  inch thicker than is required by the said Table. If a bulkhead is at the end of a coal bunker space, the lowest strake thereof shall be at least 36 inches high and  $\cdot 1$  inch thicker than is required by the said Table. In all other bulkheads the lowest strake shall be at least  $\cdot 04$  inch thicker than is required by the said Table and any limber plates shall be at least  $\cdot 1$  inch thicker.

(2) Every boundary angle shall be at least  $\cdot 1$  inch thicker than the thickness required by the said Table for the bulkhead plating to which it is attached.

(3) (a) Save as provided in Table 3 of Part IV of this Schedule, every such bulkhead shall be fitted with stiffeners which shall have brackets or lug end connections. If the stiffeners are spaced 30 inches apart, they shall comply with such of the specifications in Tables 2 and 3 of the said Part as apply to them in the circumstances. Provided that other forms of stiffeners may be used if they afford not less strength and stiffness than the stiffeners indicated in the said Tables. If any stiffeners are spaced otherwise than 30 inches apart on such a bulkhead, their strength and stiffness shall be increased or decreased, as the case may be, in direct proportion to their distance apart. Stiffeners shall not be spaced more than 24 inches apart on a collision bulkhead, or more than 36 inches apart on any other bulkhead.

(b) The lower end of each stiffener shall be attached to the shell plating, to the inner bottom plating or to horizontal plating which will support it properly.

(c) At each deck level which forms the top of a system of stiffeners plating shall be so provided as to ensure horizontal rigidity in the bulkhead.

(d) In the case of bracketed hold stiffeners the lower bracket or its connecting angle shall extend over the floor adjacent to the bulkhead and the upper bracket shall be connected to an angle which extends over the beam space, or other equally effective means shall be adopted for securing structural rigidity.

(e) Where stiffeners are cut in way of watertight doors in the lower part of a bulkhead, the opening shall be properly framed and bracketed, and a tapered web plate or buttress, stiffened on its edge, shall be fitted at each side of the door from the base of the bulkhead to above the door opening.

(f) All brackets, lugs and other end connections for stiffeners shall comply with the requirements of Table 4 of Part IV of this Schedule.

(4) (a) The rivets in seams and connections of plating and boundary bars of all bulkheads required by these Rules to be watertight shall be spaced not more than  $4\frac{1}{2}$  diameters apart centre to centre, except in the case of the flange of a boundary angle, being the flange connected to the inner bottom plating, shell plating or deck plating, in which case they shall be spaced 5 diameters apart centre to centre.

(b) Boundary angles fitted more than 35 feet below the bulkhead deck shall be double riveted in both flanges except on parts of a bulkhead within a double bottom, and the vertical connection of plates so fitted shall be double riveted.

(c) The rivets connecting stiffeners, having bracket end connections, to bulkhead plating shall be spaced not more than 7 diameters apart centre to centre. All other stiffeners shall be connected to the bulkhead plating by rivets spaced not more than 4 diameters apart centre to centre for 15 per cent. of the length of the stiffeners at each end thereof and not more than 7 diameters apart centre to centre elsewhere.

(d) Where frames or beams pass through a bulkhead required by these Rules to be watertight, the bulkhead shall be made watertight without the use of wood or cement.

### *3. Watertight Decks, Steps and Flats*

(1) The horizontal plating of decks, steps and flats required by these Rules to be watertight shall be at least .04 inch thicker than that required for watertight bulkheads at corresponding levels.

(2) The beams of such decks, steps and flats shall be of sizes indicated for stiffeners spaced 30 inches apart in Table 3 of Part IV of this Schedule. Provided that beams divided into portions which are bracketed at each end may be of the sizes indicated for such stiffeners in Table 2 of Part IV of this Schedule. If any beams are spaced otherwise than 30 inches apart, their strength and stiffness shall be increased or decreased, as the case may be, in direct proportion to their distance apart.

For the purposes of the said Tables the greatest distance between the points of support shall be deemed to be the length of the beam. Provided that, if a beam is bracketed, the length thereof for the purposes of the said Table 3 shall be reduced by the width of the brackets. The distance from the bulkhead deck to the deck, step or flat concerned, minus half the length of the beam, shall be deemed to be the height for the purposes of the said Tables.

(3) Adequate supports for such beams shall be provided by bulkheads, or by girders pillared where necessary, and the rivet connections of the pillars shall be sufficient to withstand the load due to water pressure.

(4) Where frames pass through a deck, step or flat required by these Rules to be watertight, such deck, step or flat shall be made watertight without the use of wood or cement.

### *4. Watertight Recesses and Trunkways*

Every recess and trunkway required by these Rules to be watertight shall be so constructed as to provide strength and stiffness at all parts not less than that required for watertight bulkheads at a corresponding level.

### *5. Watertight Tunnels*

(1) Every tunnel required by these Rules to be watertight shall be constructed with plating of thicknesses not less than those indicated in Table I of Part IV of this Schedule.

(2) Every such tunnel shall be fitted with stiffeners which, if spaced 36 inches apart, shall comply with such of the specifications in Table 5 of Part IV of this Schedule as apply to them in the circumstances. Provided that other forms of stiffeners may be used if they afford not less strength and stiffness than the stiffeners indicated in the said Table. If any stiffeners are spaced otherwise than 36 inches apart on such a tunnel their strength and stiffness shall be increased or decreased as the case may be in direct proportion to their distance apart. The feet of all stiffeners, however spaced, shall overlap the tunnel base angle, and shall be attached thereto.

### *6. Watertight Inner Skins*

Every inner skin required by these Rules to be watertight shall be of such strength and construction as will enable it to withstand a head of water up to the margin line.



## **PART II**

### **SHIPS OF CLASSES II AND II(A)**

#### **7. General**

Subject to the modifications set forth in this Part of this Schedule, Part I of this Schedule shall apply in relation to ships of Classes II and II(A) as it applies in relation to ships of Class I.

#### **8. Bulkheads, etc.**

(1) Every riveted portion of the ship's internal structure required by these Rules to be watertight shall be constructed as follows:

(a) In ships not exceeding 150 feet in length, in accordance with Tables 1A, 2A, 3A, 4 and 5A of Part IV of this Schedule.

(b) In ships 250 feet in length and upwards, in accordance with Tables 1, 2, 3, 4 and 5 of Part IV of this Schedule.

(c) In ships between 150 feet and 250 feet in length, in a manner determined by interpolation between the two foregoing standards. Provided that in ships of any length the subdivision of which is determined in accordance with sub-paragraph (1) of paragraph 9 of the Second Schedule to these Rules, every riveted portion of such internal structure may be constructed in accordance with Tables 1A, 2A, 3A, 4 and 5A of Part IV of this Schedule.

(2) Any bulkheads required by these Rules to be watertight in ships not exceeding 150 feet in length and in ships the subdivision of which is determined in accordance with sub-paragraph (1) of paragraph 9 of the Second Schedule to these Rules may, if the stiffeners comply with the specifications in Table 3B of Part IV of this Schedule, be fitted with stiffeners not having bracket or lug end connections.

## **PART III**

### **SHIPS OF CLASSES III TO VI INCLUSIVE**

#### **9. General**

Subject to the modifications set forth in this Part of this Schedule, Part I of this Schedule shall apply in relation to ships of Classes III to VI, inclusive, as it applies in relation to ships of Class I.

#### **10. Bulkheads, etc.**

(1) Any bulkheads required by these Rules to be watertight may be fitted with stiffeners not having bracket or lug end connections.

(2) Every riveted portion of the ship's internal structure required by these Rules to be watertight shall be constructed in accordance with such of the provisions of Tables 1A, 2A, 3A, 3B, 4 and 5A of Part IV of this Schedule as apply to it in the circumstances.

PART IV

TABLE I

(paragraphs 2, 5 and 8 of this Schedule)

THICKNESSES OF BULKHEAD AND TUNNEL PLATING

Plating of Collision Bulkhead: Stiffeners spaced 24 inches apart. Plating of Bulkheads (other than the Collision Bulkhead) and Flat Plating of Tunnels: Stiffeners spaced 30 inches apart Curved Plating of Tunnels: Stiffeners spaced 36 inches apart			Plating of Bulkheads (other than the Collision Bulkhead) and Flat Plating of Tunnels: Stiffeners spaced 36 inches apart		
Depth at Middle Line from Bulkhead Deck to Lower Edge of Plate in feet		Thickness in inches	Depth at Middle Line from Bulkhead Deck to Lower Edge of Plate in feet		Thickness in inches
<i>Above</i> —	<i>Not above</i> 8	.26	<i>Above</i> —	<i>Not above</i> 7	.28
8	12	.28	7	10.5	.30
12	16	.30	10.5	14	.32
16	20	.32	14	17.5	.34
20	24	.34	17.5	21	.36
24	28	.36	21	24.5	.38
28	32	.38	24.5	28	.40
32	36	.40	28	31.5	.42
36	40	.42	31.5	35	.44
40	44	.44	35	38.5	.46
44	48	.46	38.5	42	.48
48	52	.48	42	45.5	.50
52	56	.50	45.5	49	.52
56	60	.52	49	52.5	.54
			52.5	56	.56
			56	59.5	.58

If the stiffeners are spaced otherwise than is specified above, the thicknesses of the plating shall be such as will result in a strength equivalent to that resulting from the thicknesses and spacings specified above.

TABLE 2

(paragraphs 2, 3 and 8 of this Schedule)

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH BRACKET  
END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Con- nections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet				
	0	2	4	6	8
8	4 × 3 × .30	4½ × 3 × .30	4½ × 3 × .34	5 × 3 × .32	6 × 3 × .32
9	4½ × 3 × .32	5 × 3 × .32	5 × 3 × .36	6 × 3 × .32	6 × 3 × .36
10	5 × 3 × .34	6 × 3 × .32	6 × 3 × .34	6 × 3 × .38	5½ × 3 × .32
11	6 × 3 × .32	6 × 3 × .34	5½ × 3 × .32	5½ × 3 × .38	6 × 3 × .34
12	6 × 3 × .38	5½ × 3 × .34	6 × 3 × .34	6 × 3½ × .35	7 × 3 × .33
13	5½ × 3 × .37	6 × 3 × .35	7 × 3 × .33	7 × 3 × .33	7 × 3 × .38
14	6 × 3 × .35	7 × 3 × .33	7 × 3 × .36	7 × 3 × .40	8 × 3 × .35
15	7 × 3 × .33	7 × 3 × .36	8 × 3 × .35	8 × 3 × .35	8 × 3 × .40
16	7 × 3 × .36	8 × 3 × .35	8 × 3 × .37	8 × 3 × .42	9 × 3½ × .38
17	8 × 3 × .35	8 × 3 × .37	8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .40
18	8 × 3 × .37	8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .44	9 × 3½ × .51
19	8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .45	10 × 3½ × .40	10 × 3½ × .42
20	9 × 3½ × .38	9 × 3½ × .51	10 × 3½ × .40	11 × 3½ × .43	11 × 3½ × .43
21	9 × 3½ × .51	10 × 3½ × .40	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .44
22	10 × 3½ × .40	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .50	12 × 3½ × 3½ × .50 .38
23	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .50	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .42
24	11 × 3½ × .43	11 × 3½ × .50	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .44

- (1) The sizes of stiffeners are specified in inches.
- (2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.
- (3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness hat of the flange.
- (4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 4A-1934, 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.



TABLE 2—continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH BRACKET END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet		Height of Bulkhead Deck above Top of Stiffener, in feet			
		10	12	14	16
8	Angles	6 × 3 × .32	6 × 3 × .34	6 × 3 × .36	5½ × 3 × .32
9		6 × 3 × .38	5½ × 3 × .32	5½ × 3 × .37	6 × 3 × .34
10		6 × 3 × .34	6 × 3 × .35	6 × 3½ × .35	7 × 3 × .33
11		7 × 3 × .33	7 × 3 × .33	7 × 3 × .34	7 × 3 × .38
12		7 × 3 × .36	7 × 3 × .38	8 × 3 × .35	8 × 3 × .35
13		8 × 3 × .35	8 × 3 × .35	8 × 3 × .37	8 × 3 × .42
14		8 × 3 × .37	8 × 3 × .42	8 × 3½ × .46	9 × 3½ × .38
15		8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .38	9 × 3½ × .45
16	Bulb Angles	9 × 3½ × .38	9 × 3½ × .44	9 × 3½ × .51	10 × 3½ × .40
17		9 × 3½ × .51	10 × 3½ × .40	10 × 3½ × .42	11 × 3½ × .43
18		10 × 3½ × .40	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .44
19		11 × 3½ × .43	11 × 3½ × .43	11 × 3½ × .52	12 × 3½ × 3½ × .50 .38
20		11 × 3½ × .43	11 × 3½ × .52	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .42
21		11 × 3½ × .54	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .46
22		12 × 3½ × 3½ × .50 .39	12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .48
23		12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .50	12 × 4 × 4 × .60 .67
24	Channels	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .54	12 × 4 × 4 × .60 .70	15 × 4 × 4 × .62 .41

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 4A-1934, 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.

TABLE 2—continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH BRACKET END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet			
	18	20	22	24
8	$5\frac{1}{2} \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .37$	$6 \times 3 \times .34$	$6 \times 3 \times .35$
9	$6 \times 3 \times .35$	$7 \times 3 \times .33$	$7 \times 3 \times .33$	$7 \times 3 \times .33$
10	$7 \times 3 \times .33$	$7 \times 3 \times .36$	$7 \times 3 \times .40$	$8 \times 3 \times .35$
11	$8 \times 3 \times .35$	$8 \times 3 \times .35$	$8 \times 3 \times .37$	$8 \times 3 \times .37$
12	$8 \times 3 \times .37$	$8 \times 3 \times .40$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .38$
13	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .44$
14	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .51$	$9 \times 3\frac{1}{2} \times .51$	$10 \times 3\frac{1}{2} \times .40$
15	$9 \times 3\frac{1}{2} \times .51$	$10 \times 3\frac{1}{2} \times .40$	$10 \times 3\frac{1}{2} \times .50$	$11 \times 3\frac{1}{2} \times .43$
16	$10 \times 3\frac{1}{2} \times .50$	$11 \times 3\frac{1}{2} \times .43$	$11 \times 3\frac{1}{2} \times .43$	$11 \times 3\frac{1}{2} \times .44$
17	$11 \times 3\frac{1}{2} \times .43$	$11 \times 3\frac{1}{2} \times .52$	$11 \times 3\frac{1}{2} \times .52$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$ .38
18	$11 \times 3\frac{1}{2} \times .52$	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$ .38	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$ .38	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .60$ .44
19	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .50$ .38	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .60$ .44	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .60$ .44	$12 \times 4 \times 4 \times .60$ .40
20	$12 \times 3\frac{1}{2} \times 3\frac{1}{2} \times .60$ .44	$12 \times 4 \times 4 \times .60$ .40	$12 \times 4 \times 4 \times .60$ .48	$12 \times 4 \times 4 \times .60$ .52
21	$12 \times 4 \times 4 \times .60$ .48	$12 \times 4 \times 4 \times .60$ .50	$12 \times 4 \times 4 \times .60$ .67	$12 \times 4 \times 4 \times .60$ .70
22	$12 \times 4 \times 4 \times .60$ .67	$12 \times 4 \times 4 \times .60$ .70	$15 \times 4 \times 4 \times .62$ .41	$15 \times 4 \times 4 \times .62$ .41
23	$15 \times 4 \times 4 \times .62$ .41	$15 \times 4 \times 4 \times .62$ .41	$15 \times 4 \times 4 \times .62$ .46	$15 \times 4 \times 4 \times .62$ .50
24	$15 \times 4 \times 4 \times .62$ .46	$15 \times 4 \times 4 \times .62$ .48		

- (1) The sizes of stiffeners are specified in inches.
- (2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.
- (3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.
- (4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.

TABLE 2—continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH BRACKET END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet			
	26	28	30	32
8	6 × 3 × .39	7 × 3 × .33	7 × 3 × .33	7 × 3 × .33
9	7 × 3 × .36	7 × 3 × .40	8 × 3 × .35	8 × 3 × .35
10	8 × 3 × .35	8 × 3 × .35	8 × 3 × .37	8 × 3 × .40
11	8 × 3 × .42	8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .38
12	9 × 3½ × .38	9 × 3½ × .38	9 × 3½ × .45	9 × 3½ × .51
13	9 × 3½ × .51	10 × 3½ × .40	10 × 3½ × .40	10 × 3½ × .42
14	10 × 3½ × .42	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .43
15	11 × 3½ × .43	11 × 3½ × .44	11 × 3½ × .50	11 × 3½ × .54
16	11 × 3½ × .52	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .39
17	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .46
18	12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .50
19	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .52	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .70
20	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .70	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41
21	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .50
22	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .50		
23				
24				

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.



TABLE 2—continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH BRACKET END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet			
	34	36	38	40
8	7 × 3 × .36	7 × 3 × .36	7 × 3 × .40	8 × 3 × .35
9	8 × 3 × .35	8 × 3 × .37	8 × 3 × .37	8 × 3 × .40
10	8 × 3½ × .44	8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .38
11	9 × 3½ × .38	9 × 3½ × .44	9 × 3½ × .45	9 × 3½ × .51
12	9 × 3½ × .51	10 × 3½ × .40	10 × 3½ × .40	10 × 3½ × .50
13	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .43	11 × 3½ × .43
14	11 × 3½ × .44	11 × 3½ × .50	11 × 3½ × .54	12 × 3½ × 3½ × .50 .38
15	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .39	12 × 3½ × 3½ × .60 .44
16	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .48
17	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .52	12 × 4 × 4 × .60 .67
18	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .70	15 × 4 × 4 × .62 .41
19	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .46
20	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .48		
21				
22				
23				
24				

(1) The sizes of stiffeners are specified in inches

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.

TABLE 3

(paragraphs 2, 3 and 8 of this Schedule)

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH LUG END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet				
	0	2	4	6	8
8	*4½ x 3 x .34	5 x 3 x .36	6 x 3 x .32	6 x 3 x .38	5½ x 3 x .34
9	*6 x 3 x .32	6 x 3 x .32	5½ x 3 x .34	5½ x 3 x .38	6 x 3 x .34
10	*6 x 3 x .38	5½ x 3 x .37	6 x 3 x .34	7 x 3 x .33	7 x 3 x .33
11	5½ x 3 x .38	6 x 3½ x .35	7 x 3 x .33	7 x 3 x .36	7 x 3 x .40
12	6 x 3 x .39	7 x 3 x .33	7 x 3 x .38	8 x 3 x .35	8 x 3 x .35
13	7 x 3 x .33	7 x 3 x .40	8 x 3 x .35	8 x 3 x .40	8 x 3½ x .46
14	7 x 3 x .41	8 x 3 x .35	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .40
15	8 x 3 x .35	8 x 3 x .47	9 x 3½ x .38	9 x 3½ x .45	10 x 3½ x .40
16	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .40	10 x 3½ x .48
17	9 x 3½ x .40	9 x 3½ x .51	10 x 3½ x .42	11 x 3½ x .43	11 x 3½ x .43
18	9 x 3½ x .51	10 x 3½ x .45	11 x 3½ x .43	11 x 3½ x .44	11 x 3½ x .56
19	10 x 3½ x .42	11 x 3½ x .43	11 x 3½ x .45	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .50 .39
20	11 x 3½ x .43	11 x 3½ x .48	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .60 .44	12 x 3½ x 3½ x .60 .46
21	11 x 3½ x .48	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .60 .44	12 x 4 x 4 x .60 .40	12 x 4 x 4 x .60 .48
22	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .60 .44	12 x 4 x 4 x .60 .40	12 x 4 x 4 x .60 .52	12 x 4 x 4 x .60 .67
23	12 x 3½ x 3½ x .60 .44	12 x 4 x 4 x .60 .40	12 x 4 x 4 x .60 .54	12 x 4 x 4 x .60 .70	15 x 4 x 4 x .62 .41
24	12 x 4 x 4 x .60 .40	12 x 4 x 4 x .60 .56	12 x 4 x 4 x .60 .74	15 x 4 x 4 x .62 .41	15 x 4 x 4 x .62 .48

- (1) The sizes of stiffeners are specified in inches.
- (2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.
- (3) The ends of upper between deck stiffeners marked \* may be riveted to boundary bars only without lug end connections.
- (4) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.
- (5) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 4A-1934, 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.

TABLE 3—continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH LUG END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet			
	10	12	14	16
8	5½ × 3 × .38	6 × 3 × .34	6 × 3 × .40	7 × 3 × .33
9	6 × 3 × .39	7 × 3 × .33	7 × 3 × .36	7 × 3 × .36
10	7 × 3 × .36	7 × 3 × .40	8 × 3 × .35	8 × 3 × .35
11	8 × 3 × .35	8 × 3 × .37	8 × 3 × .42	8 × 3½ × .46
12	8 × 3 × .42	9 × 3½ × .38	9 × 3½ × .38	9 × 3½ × .40
13	9 × 3½ × .38	9 × 3½ × .44	9 × 3½ × .51	10 × 3½ × .40
14	9 × 3½ × .51	10 × 3½ × .40	10 × 3½ × .45	11 × 3½ × .43
15	10 × 3½ × .42	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .45
16	11 × 3½ × .43	11 × 3½ × .44	11 × 3½ × .45	12 × 3½ × 3½ × .50 .38
17	11 × 3½ × .48	11 × 3½ × .56	12 × 3½ × 3½ × .50 .39	12 × 3½ × 3½ × .60 .44
18	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .48
19	12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .52	12 × 4 × 4 × .60 .67
20	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .70	15 × 4 × 4 × .62 .41
21	12 × 4 × 4 × .60 .67	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .50
22	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .46		
23	15 × 4 × 4 × .62 .46			
24				

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specification Numbers 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.



TABLE 3--continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH LUG END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet			
	18	20	22	24
8	7 × 3 × .33	7 × 3 × .36	7 × 3 × .38	7 × 3 × .41
9	7 × 3 × .46	8 × 3 × .35	8 × 3 × .37	8 × 3 × .40
10	8 × 3 × .40	8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .38
11	9 × 3½ × .38	9 × 3½ × .40	9 × 3½ × .45	9 × 3½ × .51
12	9 × 3½ × .51	10 × 3½ × .40	10 × 3½ × .42	10 × 3½ × .46
13	10 × 3½ × .45	11 × 3½ × .43	11 × 3½ × .43	11 × 3½ × .44
14	11 × 3½ × .43	11 × 3½ × .45	11 × 3½ × .55	12 × 3½ × 3½ × .50 .38
15	11 × 3½ × .56	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .44
16	12 × 3½ × 3½ × .50 .42	12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .48
17	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .70
18	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .70	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41
19	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .46	
20	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .53		
21				
22				
23				
24				

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.

TABLE 3—continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH LUG END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet			
	26	28	30	32
8	8 × 3 × .35	8 × 3 × .35	8 × 3 × .37	8 × 3 × .40
9	8 × 3½ × .46	9 × 3½ × .38	9 × 3½ × .38	9 × 3½ × .38
10	9 × 3½ × .40	9 × 3½ × .45	9 × 3½ × .51	10 × 3½ × .40
11	10 × 3½ × .40	10 × 3½ × .42	10 × 3½ × .50	11 × 3½ × .43
12	10 × 3½ × .50	11 × 3½ × .43	11 × 3½ × .45	11 × 3½ × .52
13	11 × 3½ × .52	11 × 3½ × .55	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .42
14	12 × 3½ × 3½ × .50 .42	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .44	12 × 4 × 4 × .60 .40
15	12 × 4 × 4 × .60 .40	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .52	12 × 4 × 4 × .60 .67
16	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .67	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41
17	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .50
18	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .53		
19				
20				
21				
22				
23				
24				

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.

TABLE 3—continued

SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH LUG END CONNECTIONS AT TOP AND BOTTOM IN ACCORDANCE WITH TABLE 4

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet			
	34	36	38	40
8	8 × 3 × .44	9 × 3½ × .38	9 × 3½ × .38	9 × 3½ × .38
9	9 × 3½ × .40	9 × 3½ × .45	9 × 3½ × .51	10 × 3½ × .40
10	10 × 3½ × .40	10 × 3½ × .42	10 × 3½ × .50	11 × 3½ × .43
11	11 × 3½ × .43	11 × 3½ × .43	11 × 3½ × .45	11 × 3½ × .52
12	11 × 3½ × .55	12 × 3½ × 3½ × .50 .38	12 × 3½ × 3½ × .50 .39	12 × 3½ × 3½ × .60 .44
13	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .44	12 × 3½ × 3½ × .60 .46	12 × 4 × 4 × .60 .48
14	12 × 4 × 4 × .60 .48	12 × 4 × 4 × .60 .50	12 × 4 × 4 × .60 .67	12 × 4 × 4 × .60 .67
15	12 × 4 × 4 × .60 .67	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .41	15 × 4 × 4 × .62 .46
16	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .46	15 × 4 × 4 × .62 .50	
17				
18				
19				
20				
21				
22				
23				
24				

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.



**TABLE 4**  
(paragraphs 2, 8 and 10 of this Schedule)  
**END CONNECTIONS FOR STIFFENERS**

Type and Depth of Stiffener	Bracket End Connections			Lug End Connections
	Thickness of Bracket in inches	Width of Flange in inches	Number and Size of Rivets in each arm of Bracket	Number and Size of Rivets in Lugs
Angles 6" and under .	.34		3 @ 1" diameter	2 @ 1" diameter
Bulb Angles 6" and under	.36		3 @ 1" ..	2 @ 1" ..
Bulb Angles 7" . . .	.40		4 @ 1" ..	3 @ 1" ..
" " 8" . . .	.42		5 @ 1" ..	3 @ 1" ..
" " 9" . . .	↑ Flanged ↓	2½	6 @ 1" ..	4 @ 1" ..
" " 10" . . .		2½	7 @ 1" ..	4 @ 1" ..
" " 11" . . .		2½	7 @ 1" ..	4 @ 1" ..
" " 12" . . .		3	8 @ 1" ..	5 @ 1" ..
Channels 12" x 3½" x 3½" .		3	9 @ 1" ..	6 @ 1" ..
" 12" x 4" x 4" .		3	10 @ 1" ..	7 @ 1" ..
" 15" x 4" x 4" .	.44	3½	13 @ 1" ..	8 @ 1" ..

- (1) The distance from the heel of the boundary bar to the extremities of the arms of the bracket shall not be less than two and one-half times the depth of the stiffener to which the bracket is connected.
- (2) The overlap of stiffeners on brackets shall not be less than .12 of the span.

**TABLE 5**  
(paragraphs 5 and 8 of this Schedule)  
**SIZES OF TUNNEL STIFFENERS SPACED 36 INCHES APART**

Mean Height from Base of Tunnel to Bulkhead Deck in feet	Height from Base of Tunnel to the Top of Flat Side in feet					
	3	4	5	6	7	8
12	$3 \times 2\frac{1}{2} \times .24$	$4 \times 2\frac{1}{2} \times .26$	$4\frac{1}{2} \times 3 \times .30$	$5 \times 3 \times .34$	$6 \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .32$
16	$3\frac{1}{2} \times 2\frac{1}{2} \times .25$	$4 \times 3 \times .30$	$5 \times 3 \times .32$	$6 \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .32$	$6 \times 3 \times .34$
20	$3\frac{1}{2} \times 2\frac{1}{2} \times .26$	$4\frac{1}{2} \times 3 \times .30$	$6 \times 3 \times .32$	$6 \times 3 \times .38$	$6 \times 3 \times .34$	$7 \times 3 \times .33$
24	$4 \times 2\frac{1}{2} \times .28$	$5 \times 3 \times .32$	$6 \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .37$	$6 \times 3\frac{1}{2} \times .35$	$7 \times 3 \times .36$
28	$4 \times 3 \times .30$	$5 \times 3 \times .36$	$6 \times 3 \times .40$	$6 \times 3 \times .34$	$7 \times 3 \times .33$	$8 \times 3 \times .35$
32	$4\frac{1}{2} \times 3 \times .30$	$6 \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .37$	$7 \times 3 \times .33$	$7 \times 3 \times .38$	$8 \times 3 \times .37$
36	$4\frac{1}{2} \times 3 \times .32$	$6 \times 3 \times .32$	$6 \times 3 \times .34$	$7 \times 3 \times .33$	$7 \times 3 \times .45$	$8 \times 3 \times .42$
40	$4\frac{1}{2} \times 3 \times .34$	$6 \times 3 \times .38$	$6 \times 3 \times .35$	$7 \times 3 \times .36$	$8 \times 3 \times .37$	$9 \times 3\frac{1}{2} \times .38$
44	$5 \times 3 \times .32$	$6 \times 3 \times .40$	$7 \times 3 \times .33$	$8 \times 3 \times .35$	$8 \times 3 \times .42$	$9 \times 3\frac{1}{2} \times .38$
48	$5 \times 3 \times .36$	$5\frac{1}{2} \times 3 \times .32$	$7 \times 3 \times .33$	$8 \times 3 \times .35$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .45$
52	$6 \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .37$	$7 \times 3 \times .36$	$8 \times 3 \times .37$	$9 \times 3\frac{1}{2} \times .38$	$10 \times 3\frac{1}{2} \times .40$
56	$6 \times 3 \times .32$	$6 \times 3 \times .34$	$7 \times 3 \times .36$	$8 \times 3 \times .42$	$9 \times 3\frac{1}{2} \times .38$	$10 \times 3\frac{1}{2} \times .40$
60	$6 \times 3 \times .32$	$6 \times 3 \times .35$	$8 \times 3 \times .35$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .51$	$10 \times 3\frac{1}{2} \times .50$

(1) The sizes of the stiffeners are specified in inches.

(2) Sizes for intermediate heights shall be determined by interpolation.

(3) Angle Stiffeners of 6 inches in depth and all bulb angle stiffeners shall be connected to the inner bottom plating by a lug.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications 4A-1934 and 6-1924 applicable to stiffeners of the scantlings and type indicated.

**TABLE 1A**  
**(Paragraphs 8 and 10 of this Schedule)**

**THICKNESSES OF BULKHEAD AND TUNNEL PLATING**

<b>Plating of Collision Bulkhead:  Stiffeners spaced 24 inches apart.  Plating of Bulkheads (other than the  Collision Bulkhead) and Flat Plating of  Tunnels:  Stiffeners spaced 30 inches apart  Curved Plating of Tunnels:  Stiffeners spaced 36 inches apart</b>			<b>Plating of Bulkheads (other than the  Collision Bulkhead) and Flat Plating of  Tunnels:  Stiffeners spaced 36 inches apart</b>		
<b>Depth at Middle Line from  Bulkhead Deck to Lower  Edge of Plate in feet</b>		<b>Thickness  in  inches</b>	<b>Depth at Middle Line from  Bulkhead Deck to Lower  Edge of Plate in feet</b>		<b>Thickness  in  inches</b>
<i>Above</i> —	<i>Not above</i> 7	.18	<i>Above</i> —	<i>Not above</i> 8	.22
7	9	.20	8	10	.24
9	11	.22	10	12	.26
11	14	.24	12	14	.28
14	16.5	.26	14	16	.30
16.5	19	.28	16	18	.32
19	22	.30	18	21	.34
22	25	.32	21	23	.36
—	—	—	23	26	.38
25	28	.34	26	29	.40
28	31	.36	29	31.5	.42

If the stiffeners are spaced otherwise than is specified above, the thicknesses of the plating shall be such as will result in a strength equivalent to that resulting from the thicknesses and spacings specified above.



**TABLE 2A**  
(paragraphs 8 and 10 of this Schedule)

**SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH BRACKET END CONNECTIONS AT TOP AND BOTTOM  
IN ACCORDANCE WITH TABLE 4**

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet									
	0	2	4	6	8	10	12	14	16	18
6					$4 \times 2\frac{1}{2} \times .25$	$4 \times 2\frac{1}{2} \times .26$	$4 \times 3 \times .30$	$4 \times 3 \times .34$	$4\frac{1}{2} \times 3 \times .30$	$4\frac{1}{2} \times 3 \times .32$
7					$4\frac{1}{2} \times 2\frac{1}{2} \times .28$	$4\frac{1}{2} \times 3 \times .30$	$4\frac{1}{2} \times 3 \times .32$	$5 \times 3 \times .30$	$5 \times 3 \times .34$	$5 \times 3 \times .36$
8	$3 \times 2\frac{1}{2} \times .24$	$3\frac{1}{2} \times 2\frac{1}{2} \times .26$	$4 \times 2\frac{1}{2} \times .28$	$4\frac{1}{2} \times 3 \times .30$	$5 \times 3 \times .30$	$6 \times 3 \times .32$	$6 \times 3 \times .32$	$6 \times 3 \times .32$	$5 \times 2\frac{1}{2} \times .34$	$5 \times 2\frac{1}{2} \times .34$
9	$3\frac{1}{2} \times 2\frac{1}{2} \times .26$	$4 \times 2\frac{1}{2} \times .28$	$4\frac{1}{2} \times 3 \times .30$	$5 \times 3 \times .30$	$6 \times 3 \times .32$	$6 \times 3 \times .32$	$5 \times 2\frac{1}{2} \times .34$	$5 \times 2\frac{1}{2} \times .36$	$5\frac{1}{2} \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .34$
10	$4 \times 2\frac{1}{2} \times .28$	$4\frac{1}{2} \times 3 \times .30$	$5 \times 3 \times .32$	$6 \times 3 \times .32$	$5 \times 2\frac{1}{2} \times .34$	$5 \times 2\frac{1}{2} \times .36$	$5\frac{1}{2} \times 3 \times .34$	$5\frac{1}{2} \times 3 \times .37$	$6 \times 3 \times .34$	$6 \times 3 \times .35$
11	$4\frac{1}{2} \times 3 \times .30$	$5 \times 3 \times .32$	$6 \times 3 \times .32$	$5 \times 2\frac{1}{2} \times .34$	$5\frac{1}{2} \times 3 \times .32$	$5\frac{1}{2} \times 3 \times .34$	$6 \times 3 \times .34$	$7 \times 3 \times .33$	$7 \times 3 \times .33$	$7 \times 3 \times .36$
12	$5 \times 3 \times .32$	$6 \times 3 \times .32$	$5 \times 2\frac{1}{2} \times .34$	$5\frac{1}{2} \times 3 \times .32$	$6 \times 3 \times .34$	$6 \times 3 \times .35$	$7 \times 3 \times .33$	$7 \times 3 \times .36$	$7 \times 3 \times .36$	$8 \times 3 \times .35$
13	$6 \times 3 \times .32$	$5 \times 2\frac{1}{2} \times .34$	$5\frac{1}{2} \times 3 \times .32$	$6 \times 3 \times .34$	$7 \times 3 \times .33$	$7 \times 3 \times .33$	$7 \times 3 \times .36$	$8 \times 3 \times .35$	$8 \times 3 \times .35$	
14	$5 \times 2\frac{1}{2} \times .34$	$5\frac{1}{2} \times 3 \times .32$	$6 \times 3 \times .34$	$7 \times 3 \times .33$	$7 \times 3 \times .36$	$7 \times 3 \times .38$	$8 \times 3 \times .35$	$8 \times 3 \times .37$	$8 \times 3 \times .37$	
15	$5\frac{1}{2} \times 3 \times .32$	$6 \times 3 \times .34$	$7 \times 3 \times .33$	$7 \times 3 \times .36$	$7 \times 3 \times .40$	$8 \times 3 \times .35$	$8 \times 3 \times .37$	$8 \times 3\frac{1}{2} \times .46$		
16	$6 \times 3 \times .34$	$7 \times 3 \times .33$	$7 \times 3 \times .36$	$8 \times 3 \times .35$	$8 \times 3 \times .37$	$8 \times 3 \times .37$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .38$		
17	$7 \times 3 \times .33$	$7 \times 3 \times .36$	$8 \times 3 \times .35$	$8 \times 3 \times .37$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .38$			
18	$7 \times 3 \times .36$	$8 \times 3 \times .35$	$8 \times 3 \times .37$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .51$			
19	$8 \times 3 \times .35$	$8 \times 3 \times .37$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .40$	$9 \times 3\frac{1}{2} \times .51$				
20	$8 \times 3 \times .37$	$8 \times 3\frac{1}{2} \times .46$	$9 \times 3\frac{1}{2} \times .38$	$9 \times 3\frac{1}{2} \times .40$	$9 \times 3\frac{1}{2} \times .51$	$10 \times 3\frac{1}{2} \times .40$				

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) The above stiffeners shall comply with the specifications set forth in British Standard Specifications 4A-1934 and 6-1924 applicable to stiffeners of the scantlings and type indicated.

**TABLE 3A**  
(paragraphs 8 and 10 of this Schedule)

**SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART AND FITTED WITH LUG END CONNECTIONS AT TOP AND BOTTOM  
IN ACCORDANCE WITH TABLE 4**

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet									
	0	2	4	6	8	10	12	14	16	18
8					6 x 3 x .32	6 x 3 x .38	5½ x 3 x .32	5½ x 3 x .35	6 x 3 x .34	6 x 3½ x .35
9		5 x 3 x .32	6 x 3 x .32	6 x 3 x .36	5½ x 3 x .32	5½ x 3 x .37	6 x 3 x .34	7 x 3 x .33	7 x 3 x .33	7 x 3 x .36
10	5 x 3 x .30	6 x 3 x .32	6 x 3 x .38	5½ x 3 x .34	6 x 3½ x .35	7 x 3 x .33	7 x 3 x .33	7 x 3 x .36	7 x 3 x .41	8 x 3 x .35
11	6 x 3 x .32	5½ x 3 x .32	5½ x 3 x .38	6 x 3½ x .35	7 x 3 x .33	7 x 3 x .36	7 x 3 x .41	8 x 3 x .35	8 x 3 x .37	8 x 3 x .42
12	6 x 3 x .36	6 x 3 x .34	6 x 3 x .39	7 x 3 x .33	7 x 3 x .40	8 x 3 x .35	8 x 3 x .35	8 x 3 x .42	9 x 3½ x .38	9 x 3½ x .38
13	6 x 3 x .34	7 x 3 x .33	7 x 3 x .33	7 x 3 x .41	8 x 3 x .35	8 x 3 x .40	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .44	
14	7 x 3 x .33	7 x 3 x .36	8 x 3 x .35	8 x 3 x .37	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .40	9 x 3½ x .51	10 x 3½ x .40	
15	7 x 3 x .33	8 x 3 x .35	8 x 3 x .37	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .40	10 x 3½ x .42		
16	7 x 3 x .40	8 x 3 x .37	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .40	10 x 3½ x .50	11 x 3½ x .43		
17	8 x 3 x .35	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .40	11 x 3½ x .43	11 x 3½ x .43			
18	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .42	11 x 3½ x .43	11 x 3½ x .45	12 x 3½ x 3½ x .50 .38			
19	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .42	11 x 3½ x .43	11 x 3½ x .48	12 x 3½ x 3½ x .50 .38				
20	9 x 3½ x .51	10 x 3½ x .42	11 x 3½ x .43	11 x 3½ x .48	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .50 .44				

(1) The sizes of stiffeners are specified in inches.

(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.

(3) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 4A-1934, 6-1924 and 4-1932 applicable to stiffeners of the scantlings and type indicated.

TABLE 3B  
(paragraphs 8 and 10 of this Schedule)  
SIZES OF BULKHEAD STIFFENERS SPACED 30 INCHES APART NOT FITTED WITH BRACKET OR LUG END CONNECTIONS

Overall Length of Stiffener, including End Connections, in feet	Height of Bulkhead Deck above Top of Stiffener, in feet									
	0	2	4	6	8	10	12	14	16	18
6	3 x 2½ x .23	3½ x 2½ x .26	4 x 2½ x .28	4 x 3 x .32	4½ x 3 x .32	5 x 3 x .32	6 x 3 x .32	6 x 3 x .32	6 x 3 x .34	6 x 3 x .38
7	3½ x 2½ x .25	4 x 2½ x .28	4½ x 3 x .30	5 x 3 x .32	6 x 3 x .32	6 x 3 x .32	6 x 3 x .38	5½ x 3 x .32	5½ x 3 x .34	6 x 3 x .34
8	4 x 2½ x .25	4½ x 3 x .30	5 x 3 x .34	6 x 3 x .32	6 x 3 x .38	5½ x 3 x .32	6 x 3 x .34	6 x 3 x .35	7 x 3 x .33	7 x 3 x .33
9	4½ x 3 x .30	6 x 3 x .32	6 x 3 x .34	5½ x 3 x .32	6 x 3 x .34	6 x 3½ x .35	7 x 3 x .33	7 x 3 x .36	7 x 3 x .38	8 x 3 x .35
10	6 x 3 x .32	6 x 3 x .34	5½ x 3 x .32	6 x 3 x .34	7 x 3 x .33	7 x 3 x .36	7 x 3 x .38	8 x 3 x .35	8 x 3 x .35	8 x 3 x .37
11	6 x 3 x .32	5½ x 3 x .32	6 x 3 x .35	7 x 3 x .33	7 x 3 x .36	8 x 3 x .35	8 x 3 x .35	8 x 3 x .40	8 x 3½ x .46	9 x 3½ x .38
12	5½ x 3 x .32	6 x 3 x .35	7 x 3 x .33	7 x 3 x .40	8 x 3 x .35	8 x 3 x .37	8 x 3 x .40	9 x 3½ x .38	9 x 3½ x .40	9 x 3½ x .51
13	6 x 3 x .34	7 x 3 x .33	7 x 3 x .40	8 x 3 x .35	8 x 3 x .42	9 x 3½ x .38	9 x 3½ x .38	9 x 3½ x .40	10 x 3½ x .40	
14	7 x 3 x .33	7 x 3 x .40	8 x 3 x .37	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .45	10 x 3½ x .40	10 x 3½ x .42	10 x 3½ x .50	
15	7 x 3 x .38	8 x 3 x .37	8 x 3½ x .44	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .40	10 x 3½ x .50	11 x 3½ x .43		
16	8 x 3 x .35	8 x 3½ x .46	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .40	11 x 3½ x .43	11 x 3½ x .50	11 x 3½ x .52		
17	8 x 3 x .42	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .45	11 x 3½ x .43	11 x 3½ x .50	11 x 3½ x .56			
18	9 x 3½ x .38	9 x 3½ x .51	10 x 3½ x .45	11 x 3½ x .43	11 x 3½ x .50	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .50 .44			
19	9 x 3½ x .51	10 x 3½ x .42	11 x 3½ x .43	11 x 3½ x .52	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .60 .44				
20	10 x 3½ x .40	11 x 3½ x .43	11 x 3½ x .50	12 x 3½ x 3½ x .50 .38	12 x 3½ x 3½ x .60 .44	12 x 4 x 4 x .60 .48				

(1) The sizes of stiffeners are specified in inches.  
(2) Sizes for intermediate lengths of stiffeners and heights of bulkhead deck shall be determined by interpolation.  
(3) The ends of the stiffeners shall be riveted to the bulkhead boundary angle.  
(4) In the case of Channel Sections the lower thickness is that of the web and the upper thickness that of the flange.  
(5) The above stiffeners shall comply with the requirements set forth in British Standard Specifications Numbers 44-1914, 6-1924 and 4-1922 applicable to stiffeners of the same type and size.



TABLE 5A

(paragraphs 8 and 10 of this Schedule)

## SIZES OF TUNNEL STIFFENERS SPACED 36 INCHES APART

Mean Height from Base of Tunnel to Bulkhead Deck in feet	Height from Base of Tunnel to Top of Flat Side in feet						
	3 feet 0 inches	3 feet 6 inches	4 feet 0 inches	4 feet 6 inches	5 feet 0 inches	5 feet 6 inches	6 feet 0 inches
8	$2\frac{1}{2} \times 2\frac{1}{2} \times .20$	$2\frac{1}{2} \times 2\frac{1}{2} \times .24$	$3 \times 2\frac{1}{2} \times .23$				
12	$2\frac{1}{2} \times 2\frac{1}{2} \times .24$	$3 \times 2\frac{1}{2} \times .26$	$3\frac{1}{2} \times 2\frac{1}{2} \times .25$	$4 \times 2\frac{1}{2} \times .25$	$4 \times 2\frac{1}{2} \times .28$	$4 \times 3 \times .30$	
16	$3 \times 2\frac{1}{2} \times .24$	$3\frac{1}{2} \times 2\frac{1}{2} \times .26$	$4 \times 2\frac{1}{2} \times .26$	$4 \times 3 \times .32$	$4\frac{1}{2} \times 3 \times .32$	$5 \times 3 \times .32$	$5 \times 3 \times .38$
20	$3\frac{1}{2} \times 2\frac{1}{2} \times .25$	$4 \times 2\frac{1}{2} \times .26$	$4 \times 3 \times .32$	$4\frac{1}{2} \times 3 \times .34$	$5 \times 3 \times .32$	$6 \times 3 \times .32$	$6 \times 3 \times .32$
24	$3\frac{1}{2} \times 2\frac{1}{2} \times .30$	$4 \times 3 \times .30$	$4\frac{1}{2} \times 3 \times .32$	$5 \times 3 \times .32$	$6 \times 3 \times .32$	$6 \times 3 \times .34$	$6 \times 3 \times .40$
28	$4 \times 2\frac{1}{2} \times .28$	$4\frac{1}{2} \times 3 \times .30$	$4\frac{1}{2} \times 3 \times .38$	$5 \times 3 \times .38$	$6 \times 3 \times .32$	$6 \times 3 \times .40$	$5\frac{1}{2} \times 3 \times .34$ Bulb Angles

(1) The sizes of the stiffeners are specified in inches.

(2) Sizes for intermediate heights shall be determined by interpolation.

(3) The ends of tunnel stiffeners shall be riveted to the tunnel boundary angles.

(4) The above stiffeners shall comply with the specifications set forth in British Standard Specifications Numbers 4A-1934 and 6-1924 applicable to stiffeners of the scantlings and type indicated.

## PROVISION FOR CINEMATOGRAPH EXHIBITIONS

*1. Exits from Public Rooms*

Any public room in which cinematograph exhibitions are intended to be given shall be provided with means of escape which are remote from the projector and are adequate having regard to the number of persons who may be in the audience. The doors by which such escape may be made shall be clearly marked with the word "Exit", and shall be so constructed as easily to open outwards. The seating shall be arranged in rows for the exhibitions so as not to interfere with free access to such doors.

*2. Storage of films*

(1) There shall be provided in the ship:

(a) a storage room bounded by "A" Class divisions; or

(b) a locker constructed of material capable of resisting fire as efficiently as an "A" Class division,

appropriated solely for the storage of cinematograph films intended to be exhibited in the ship. Such storage room or locker, as the case may be, shall, whenever practicable, be situated on an upper deck and in a position remote from passenger spaces. It shall be provided with an outlet to the open air with an area of not less than one square inch for each 5 pounds weight of film that may be stored in the room or locker.

(2) A metal spool box, with means of closure which will prevent the passage of flame into the box, shall be provided for the storage and projection of each spool of film, and shall be capable of being attached to and removed from the projector without being opened. Metal containers with self-closing lids shall be provided in sufficient number for the storage of the spool boxes.

*3. Projector rooms and cabinets*

(1) If the ship is provided with a film projector intended for giving cinematograph exhibitions in a public room therein, not being a portable projector, there shall be provided in the ship:

(a) a permanent projector room, which shall be bounded by "A" class divisions, and to which access shall be obtained from a space in which the audience are not accommodated, and shall, whenever practicable, be from the open air; or

(b) a fixed or portable projector cabinet made wholly of, or lined with, incombustible material.

In the following sub-paragraphs of this paragraph the expression "projector room" shall be deemed to include a projector cabinet.

(2) All fittings in the projector room shall be made wholly of, or lined with, incombustible material. The projector room shall be large enough to enable the projector to be properly operated.

(3) Every entrance to a projector room shall be provided with a self-closing door which shall open outwards and shall be well-fitting and as effective in resisting fire as the structure in which it is fitted.

(4) There shall not be provided more than two openings in the structure of the projector room for each projector in the room, whether for the projection of light or the observation of the screen. The openings shall be no larger than is required for such purposes and shall be glazed with stout plate glass.

(5) Means shall be provided which will ensure an adequate supply of fresh air within the projector room. The ventilation openings shall be covered with wire netting of mesh not less than 16 per square inch. The ventilation shall, wherever practicable, be to the open air.

(6) The openings in the projector room for projection, observation and ventilation purposes shall be fitted with close-fitting self-closing shutters capable of being simultaneously released. Means for releasing the shutters shall be provided both inside and outside the projector room. All openings through which cables pass into the projector room shall be sealed in a manner which will prevent the passage of smoke. The projector room and the doors and shutters thereof shall be so constructed that when the doors and shutters are closed the passage of smoke from the projector room will be prevented.

(7) Separate electrical circuits shall be provided for the illuminant of the projector and for the lighting of the projector room. The supply of electrical energy for the illuminant of the projector shall be capable of being controlled by two switches situated respectively inside the projector room and outside the projector room at a position sufficiently distant therefrom to enable the switch to be safely operated despite a fire in the projector room.

(8) Devices shall be provided which will prevent the films from coming into contact with any electric lamp, terminal or other electrical fitting within the projector room. All switches and fuses in the projector room shall be completely protected, and all resistances in that room shall be of a design which will prevent overheating.

#### **4. Projectors**

Every projector, not being a portable projector, provided in the ship and intended for giving cinematograph exhibitions in a public room therein shall be firmly fixed in position and shall rest upon supports constructed of incombustible material. The projector shall be fitted with a metal shutter which can be readily inserted by hand between the projector lamp and the film-gate, and with a second shutter so arranged as automatically to cut off the film-gate from the illuminant when the projector stops. The film-gate shall be of substantial construction and shall afford sufficient heating surface to dissipate the heat which may be engendered by the illuminant. The opening for the film shall be sufficiently narrow to prevent flames travelling upwards or downwards from the light-opening.

#### **5. Exhibitions on deck**

If the ship is provided with a projector, not being a portable projector, intended for giving cinematograph exhibitions on an open deck, and the illuminant of such projector is not hermetically sealed in a glass bulb, the provisions of paragraphs 3 and 4 of this Schedule shall apply to the ship and to the projector as they apply in the case of a ship provided with a projector, not being a portable projector, intended for giving cinematograph exhibitions in a public room.

#### **6. Portable projectors**

(1) Portable projectors and the illuminant thereof shall be enclosed in casing constructed of incombustible material. There shall be no openings in such casing other than those necessary for the proper operation of the projector and for ventilation of the projector casing.

(2) Spool boxes for use with portable projectors shall be so designed that they cannot contain a reel exceeding 10 inches in diameter.

(3) The electric lamp provided as the illuminant for a portable projector shall be hermetically sealed in a glass bulb and shall not exceed 1,000 watts in power.

(4) Every portable projector shall be provided with a filter or other device which shall be permanently attached thereto and shall be capable of intercepting the heat in the light rays emitted by the illuminant so as to prevent the ignition of a stationary inflammable film if the film is exposed to the rays for a period of three minutes.

#### **7. Illuminant for projectors**

The Illuminant provided for a projector shall be an electric lamp.

#### **8. "No Smoking" notices**

(1) Legible notices prohibiting smoking within 3 feet of the projector or of the projector room or cabinet, as the case may be, shall be provided for display to the audience.

(2) Legible notices prohibiting smoking shall be provided for display in the projector room or cabinet, as the case may be, the re-winding room, if any, and the film storage room.



**AUTOMATIC SPRINKLER, FIRE ALARM AND FIRE  
DETECTION SYSTEM****1. Type and charging of system**

The automatic sprinkler and fire alarm and detection system shall be of the wet type with overhead sprinklers, and shall at all times be fully charged.

**2. Details of the system**

The system shall comply with the following requirements:

**(a) Pressure tank:**

- (i) A pressure tank of adequate strength and construction having regard to the charge of water specified in this sub-paragraph shall be provided and shall have a capacity of not less than twice the standing charge of fresh water required for the automatic operation of the system. A standing charge of not less than 500 gallons of fresh water shall be capable of being maintained in the pressure tank under an air pressure of not less than 70 lb. per square inch plus the pressure due to a head of water measured from the bottom of the tank to the highest sprinkler in the system.
- (ii) The pressure tank shall be fitted with an efficient relief valve and with a water gauge glass and a pressure gauge. Stop valves or cocks shall be provided at each of the gauge connections.

**(b) Air Compressor:**

The pressure tank shall be connected to an air compressor capable of maintaining in the tank the pressure required by sub-paragraph (a) of this paragraph.

**(c) Pipes:**

- (i) The pipes forming part of the system shall be made of steel of adequate strength having regard to the pressure to which they may be subjected, and shall be properly jointed and supported.
- (ii) Connections shall be provided which will supply a replenishment of the standing fresh water charge in the pressure tank, and which will enable the pipes to be flushed with fresh water after the use of salt water in the system.
- (iii) Any pipes which may be affected by frost shall be insulated so as to prevent the water therein from freezing.

**(d) External Connections:**

The sprinkler system shall be a self-contained unit, and no external connections shall be fitted to it other than the following:

- (i) Hose couplings with shut-off valves, and non-return valves situated close to the couplings, for the purpose of coupling to a shore supply.
- (ii) A connection with the ship's fire main, provided with a shut-off screw-down non-return valve at the connection which will prevent a back flow from the sprinkler system to the fire main. Shut-off valves for the shore supply and the ship's fire main connection shall be clearly and permanently marked to show their purpose, and shall be capable of being locked in the closed position.

**(e) Pump:**

- (i) An independent power pump shall be provided solely for the purpose of continuing automatically the discharge of water from the sprinkler heads. The pump shall be brought into action automatically by the pressure drop in the system before the standing fresh water charge in the pressure tank is completely exhausted.
- (ii) The pump shall have a suction direct from the sea which shall be independent of any other suction. The pump shall have fitted close to it on the delivery side a 2 inch diameter waste valve with a short open-ended discharge pipe for testing purposes.

- (iii) The arrangements shall be such as will prevent the pump from passing sea water into the pressure tank.
- (iv) The pump shall be capable of maintaining a pressure of 25 lb. per square inch at the level of the highest sprinkler with the 2 inch diameter waste valve fully open.

**(f) Sprinkler Heads:**

- (i) Sprinkler heads shall be grouped into separate sections, each of which contains not more than 150 sprinkler heads. A section of sprinkler heads shall not serve more than two decks, and shall not be in more than one main vertical zone or in more than one watertight compartment. Provided that, in any ship, a section of sprinkler heads may serve more than two decks or be in more than one main vertical zone if the Minister is satisfied that the protection of the ship against fire is thereby improved.
- (ii) Each section of sprinkler heads shall be controlled by one control valve, and no other valves shall be provided for controlling any of the sprinklers in that section. The control valves shall be readily accessible, and their locations shall be clearly and permanently indicated. Means shall be provided to prevent the operation of the control valves by any person not authorised to do so by the master of the ship.
- (iii) A pressure gauge shall be provided at each control valve and at a central station to indicate the pressure of water available throughout the system.
- (iv) The sprinkler heads shall be capable of operating with salt water and shall come into operation at a temperature of not less than 155°F. (68°C.). They shall come into operation at a temperature of not more than 200°F. (93°C.), except in drying rooms and similar spaces.
- (v) Each sprinkler head shall be capable of discharging water at a rate of not less than 20 gallons of water per minute under a supply pressure of 25 lb. per square inch.
- (vi) At least six spare sprinkler heads shall be provided for each section. They shall be stowed in boxes or holders provided for that purpose near the control valve for the section, and the boxes or holders shall be clearly and permanently marked to show their contents.

**(g) Spacing of Sprinkler Heads:**

Sprinkler heads shall be spaced not more than 13 feet apart and not more than 6 feet 6 inches from a bulkhead. They shall be placed as clear as may be of beams or other objects likely to obstruct the projection of water and in such positions that all combustible material in the space concerned will be well sprayed.

**(h) Automatic Alarm:**

The sprinkler system shall include means for giving a visible and audible alarm signal automatically whenever any sprinkler comes into operation. The alarm signal shall indicate at one or more points in the ship, so as to come rapidly to the attention of the master and crew of the ship, the presence and position of any fire in the spaces served by the system. If such alarm is operated by electricity it shall be constructed so as to operate if any derangement occurs in the electrical circuit.

**(i) Power Supply:**

There shall be provided not less than two sources of power to operate the independent pump, air compressor and automatic alarm.

**(j) Provisions for Testing:**

- (i) A test valve shall be provided for testing the automatic alarm for each section of sprinklers by a discharge of water equivalent to the operation of one sprinkler head. The test valve for each section shall be situated near the control valve for that section.
- (ii) Means shall be provided for testing the automatic cutting in of the pump.
- (iii) Switches shall be provided at one of the points referred to in sub-paragraph (h) of this paragraph which will enable the alarm and the indicators for each section of sprinklers to be tested.

## APPENDIX II

### Flooding Curves and Tables

In accordance with the provisions of paragraph 97 of Part II of these Instructions the method described below should generally be adopted to develop flooding curves to indicate the floodable length at any point in the ship. For the purpose of this method the floodable length is expressed as a percentage of the length of the ship.

#### DEFINITIONS AND NOTES

Except where otherwise stated:

- (a) All linear measurements are to be in feet;
- (b) all area measurements are to be in square feet; and
- (c) all volumes are to be in cubic feet and calculated to moulded lines.

The *load waterplane* is that used in determining the subdivision of the ship, and is drawn parallel to the keel.

The *margin line* for a ship of standard form consists of two ordinary parabolas, each with apex at amidships and axis vertical, passing, at amidships and at the ends, through points three inches below the surface of the bulkhead deck at side.

The *corrected margin line*. If the actual margin line either forward or aft is not of ordinary parabolic form\* or if its lowest point is not at amidships, a margin line of ordinary parabolic form is to be drawn with its apex amidships level with the lowest point of the actual margin line, and intersecting the latter either at a point 1/4th of the ship's length from amidships or at the perpendicular according as the actual sheer at the perpendicular is respectively greater or less than four times the actual sheer at the 1/4th length position. (see Fig. A of this Appendix).

The *perpendiculars* are taken at the extreme ends of the subdivision load water line.

*Amidships* is the middle of the length between the perpendiculars.

The *mean waterplane* is midway between the load waterplane and that drawn parallel thereto touching the lowest point of the margin line.

The *length of the ship* (L) is the length of a ship measured between the perpendiculars taken at the extremities of the deepest subdivision load water line. (Rule 1(2)). No adjustment to this length will, as a general rule, be necessary unless the sectional area at the after perpendicular exceeds one-tenth of the midship sectional area, in which case full particulars should be submitted in order that an equitable length may be determined.

The *breadth of the ship* (B) is the greatest moulded breadth at or below the ship's deepest subdivision load water line (Rule 1(2)).

The *draught* (d) is the vertical distance from the moulded base line amidships to a subdivision load water line. (Rule 1(2)).

The *freeboard* (f) is the vertical distance amidships from the subdivision load water line to the margin line (corrected as necessary).

The *block coefficient of fineness of displacement* to the subdivision load water line shall be determined as follows: Volume of displacement to moulded lines  $\div$  (L.B.d.).

The *freeboard ratio*  $\left(\frac{f}{d}\right)$  is the ratio between the freeboard (f) and the draught (d).

The *sheer ratio* forward or aft is the ratio of the sheer of the margin line (corrected as necessary) at the forward or after perpendicular respectively, measured from the horizontal line through the lowest point of the margin line (corrected as necessary), to the draught.

The *mean waterplane area coefficient* (a) is the actual area of mean waterplane divided by L  $\times$  B.

\* A margin line of ordinary parabolic form is one in which the sheer forward and aft measured at points 1/8th, 1/4th, and 3/8ths of the length of the ship from the perpendicular is 9/16ths, 1/4th and 1/16th respectively of the sheer at the perpendicular.



The *mean waterplane moment of inertia coefficient* ( $n$ ) is the actual moment of inertia of mean waterplane about a transverse axis through its centre of flotation divided by  $L^3 \times B$ .

The *sectional area coefficient* ( $\beta$ ) for any transverse section is the actual area of that section up to the margin line divided by  $B \times d$ .

The *Standard Diagrams of Floodable Lengths, etc. (or Plates)* are published separately as Volume II of these Instructions and the Plates referred to are the numbered Diagrams in that Volume.

#### GENERAL DESCRIPTION OF METHOD

In determining the floodable length, a uniform average permeability is to be used throughout the whole length of each of the following portions of the ship below the margin line:

- (a) The machinery space;
- (b) the portion forward of the machinery space; and
- (c) the portion abaft the machinery space.

The assumptions of permeability appropriate to each Class of ship, which are to be taken into account for each of the above portions of the ship, are laid down in paragraphs 3, 8 and 11 of the Second Schedule to the Rules. (See also paragraph 98 of Part II of these Instructions).

For a given ship, therefore, three flooding curves must in general be drawn more or less completely, corresponding to the three different permeabilities, the significant part of each curve depending on the position of the bulkheads bounding the machinery space.

The size and shape of a flooding curve depend principally on the freeboard ratio and on the assumed permeability. They depend, also, to a smaller extent, on the character of the lines of the vessel and on the sheer of the margin lines forward and aft. Using the same vertical and horizontal scales for percentage of length, the ends of a flooding curve terminate on straight lines drawn through points in the base line representing the position of the fore and after perpendiculars, at an angle  $\theta$ , where  $\tan \theta = 2$ . These lines are called the forward and after terminals respectively.

In order to determine curves of floodable length for any ship the Standard Diagrams should be used. These give floodable lengths (for the two permeabilities 60 per cent. and 100 per cent.), for a definite standard family of ship forms of differing block coefficients, freeboard ratios and sheer ratios. The floodable lengths obtained are in every case to be set off at right angles to the base line of the floodable length curve. For the two permeabilities mentioned, the curves of floodable length for any vessel of the standard form can be obtained directly from the cross curves given in the Plates, by the method indicated on Plate II; whilst for any other permeability the appropriate curve may be obtained (including terminal points) as follows:

If  $l_1$  be the floodable length at the point considered for permeability 100 per cent. and  $l_2$  be the floodable length at the point considered for permeability 60 per cent. then the floodable length  $l_3$  at that point for a permeability  $\mu$  will be given by:

$$l_3 = l_1 + \frac{3}{2} (l_2 - l_1) \left( \frac{100}{\mu} - 1 \right)$$

A convenient method of arranging the work to obtain the required curves is indicated in Specimen 2 of this Appendix.

If the ship under consideration conforms to standard type, that is to say, if the coefficients (see Specimen 1 of this Appendix) agree with those given on Plates XXVI and XXVII for the standard form, the floodable length curve determined as above will hold good for the ship. If, however, there are differences in these respects, the curve obtained as above should be modified as follows:

Let A, Fig. 1, mark the fore-and-aft position of the centre of flotation of mean waterplane of the standard form, and  $A_1$ , that of the corresponding point for the ship under consideration, the horizontal distance between them being  $mL$ . Take

any point P on the standard form curve, distant  $x$  from A, the ratio  $\frac{x}{L}$  being represented by  $p$ , so that the value of  $p$  varies according to the position of P. The

longitudinal position of the point  $P_1$ , on the new curve, corresponding to the point  $P$  on the old, is given by

$$\bar{x}_1 = x \times \frac{n!}{n} \times \frac{a}{a_i} = \left(1 \pm m \frac{ap}{n}\right)$$

where  $n$  and  $n_1$  are the moment of inertia coefficients of the mean water plane of the standard form and the new form respectively. The length of the ordinate  $M_1 P_1$  is given by

$$M_1 P_1 = MP \times \frac{a_1}{a} \times \frac{\beta}{\beta_1} \times \left(1 \pm m \frac{ap}{n}\right)$$

where  $a$  and  $a_1$  are the area coefficients of the mean water planes of the standard form and the new form respectively and  $\beta$  and  $\beta_1$  are the sectional area coefficients of the standard form and the new form respectively at MP and  $M_1P_1$ . The sign to be used in the last factor of the above expressions will be + when the centre of flotation of the mean water plane of the new form is *before*, and — when it is *abaft*, that of the standard form for sections forward of the centre of flotation, and the opposite sign for sections abaft the centre of flotation. This work may be conveniently arranged as in Specimen 3 of this Appendix.

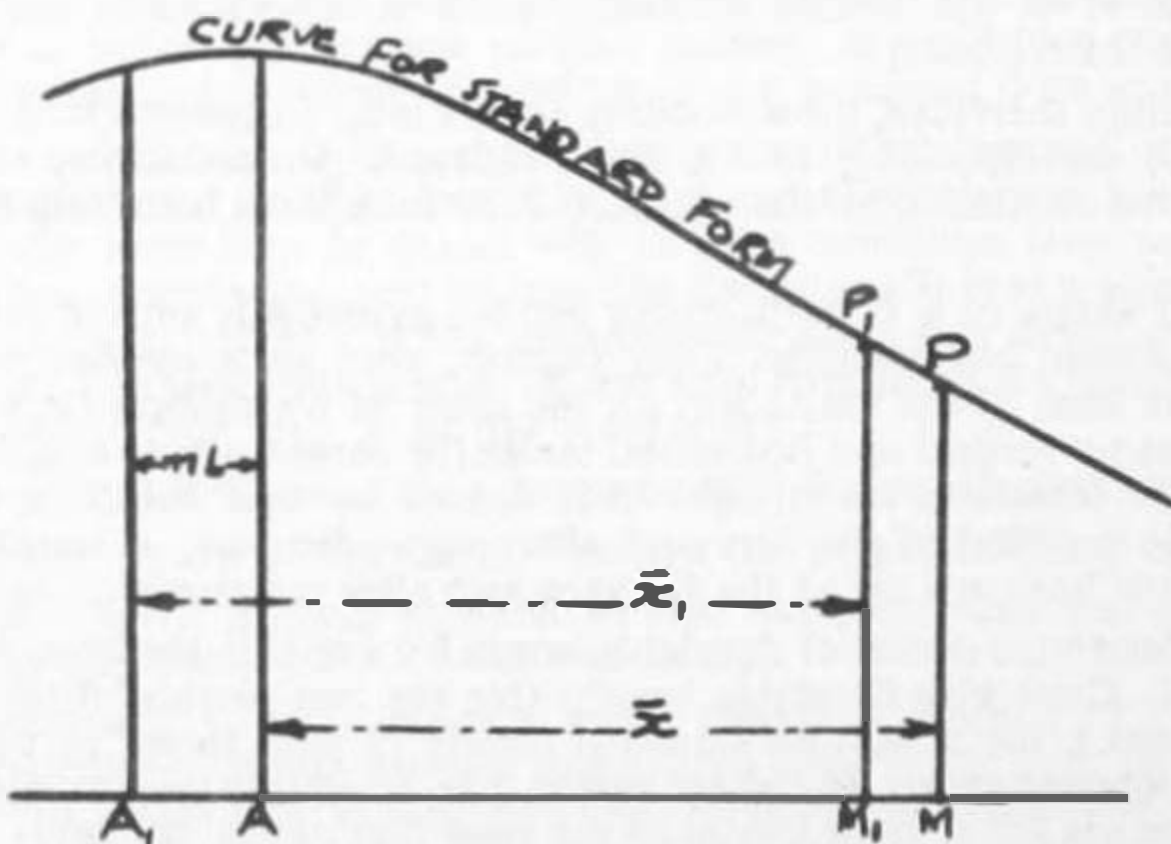
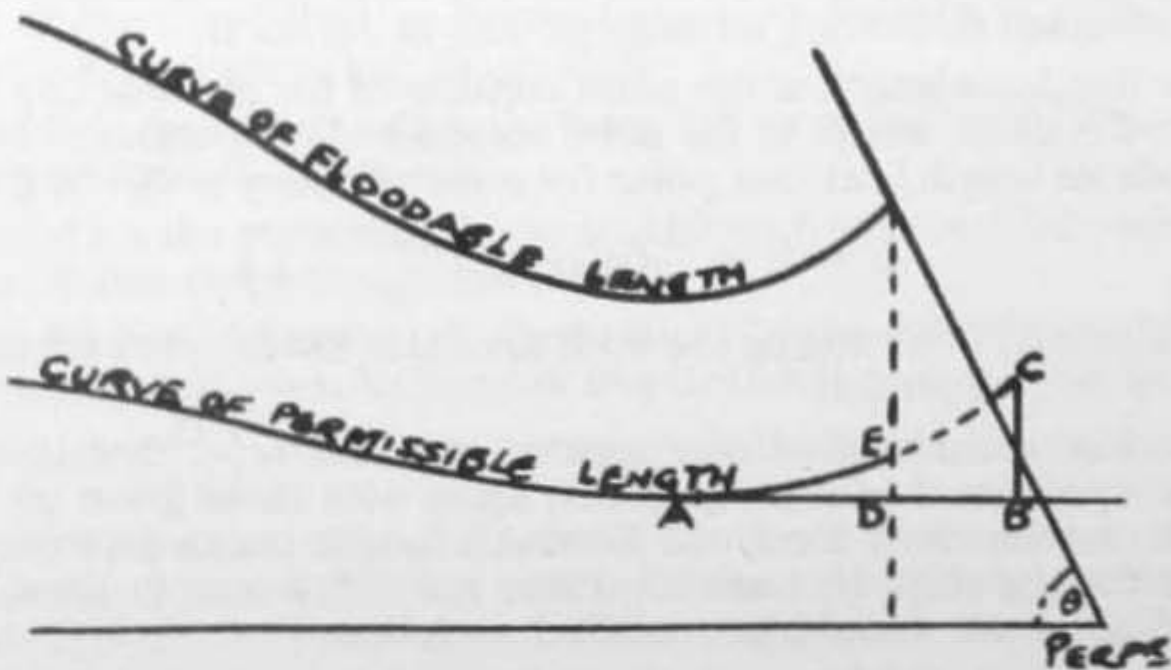


Fig. 1



**Fig. 2**

The coefficients required for a new ship may be conveniently recorded as indicated in Specimen I, whilst the similar information for standard form is given on Plates XXVI and XXVII.

It may be noted that, if the longitudinal position of the centre of flotation of mean water plane does not materially differ from that of the corresponding standard form, the factor  $\left(1 \pm m \frac{ap}{n}\right)$  may without material error be omitted for both length of ordinate and its position.

The curves of permissible length are obtained from the curve of floodable length by using the appropriate factor of subdivision, and it will be noted that these curves will not extend at the ends of the terminal lines. They can, however, be drawn in when required with sufficient accuracy, by means of the construction shown in Fig. 2. Make  $AB = 2 AD$ , and  $BC = 4 DE$ ,  $A$  being the lowest point of the curve of permissible length, and  $AB$  horizontal; then a fair curve may be drawn through  $AEC$  to meet the terminal line as shown in the diagram.



# FLOODING CALCULATION

CRITERION NUMERAL, FACTOR OF SUBDIVISION, AVERAGE PERMEABILITIES, ETC.

Name of Ship .....  
 Builders and No. of Ship.....  
 Name of Owners.....  
 Class under Construction Rules, 1952.....  
 Passenger Certificate required.....  
 Intended Service.....  
 Classification Society.....  
 Loadline Assignment by.....

SHIPS OF CLASS I, AND SHIPS OF CLASSES II AND II(A) OTHER THAN SHIPS TO WHICH PART III OF THE SECOND SCHEDULE TO CONSTRUCTION RULES APPLIES

## CRITERION NUMERAL (C<sub>s</sub>)

Subdivision Length (L) =	feet	From page 3	Whole Volume of Ship (V) =	cub. ft.
No. of Passengers (N) =			Volume of Machinery Space, etc. (M) =	
P <sub>1</sub> = .6LN =	cub. ft.		Volume of Passenger and Crew Spaces (P) =	
(1) P <sub>1</sub> greater than P		(2) P <sub>1</sub> not greater than P		
C <sub>s</sub> = 72 $\left( \frac{M + 2P_1}{V + P_1 - P} \right) =$		C <sub>s</sub> = 72 $\left( \frac{M + 2P}{V} \right) =$		

## FACTOR OF SUBDIVISION (F)

(1) L = 430 ft. and upwards.  
 Factor from Curve A:— A =  $\frac{190}{L - 198} + .18 =$   
 Factor from Curve B:— B =  $\frac{100}{L - 138} + .18 =$   
 Required Factor:— F = A —  $\frac{(A - B)(C_s - 23)}{100} =$  Para. 4(1)

(2) L = Less than 430 ft and not less than 260 ft. (C<sub>s</sub> not less than S).  
 S =  $\frac{4691 - 10L}{17} =$  Required Factor:— F = 1 —  $\frac{(1 - B)(C_s - S)}{123 - S} =$  Para. 4(2)

When C<sub>s</sub> is less than S and in all ships less than 260 ft. in length the subdivision is to be governed by the factor unity. Para. 4(3)

(3) In the case of a ship of any length which is intended to carry a number of passengers exceeding 12 but not exceeding  $\frac{L^2}{7000}$  or 50 whichever is the lower the subdivision is to be governed by the factor unity. Para. 4(4)

The paragraphs referred to above are those of the Second Schedule to the Construction Rules.

# AVERAGE PERMEABILITY ( $\mu$ ) OF AFTER END §

Passenger and Crew Spaces (a)† §§ or Other Spaces (b)‡					Whole Volume of After End	
Compartment (Reference letters as in B.H. 1)	Identification Measurements			Volume Cub. ft.	Longitudinal Error	Volume Cub. ft.
	Length	Breadth	Depth			
					Aft Bulkhead No.....	
					(1) Total (v) =	
					$\mu = 63 + 35 \frac{a}{v} \uparrow =$ $\quad \quad \quad \uparrow \uparrow =$ $\text{or } 95 - 35 \frac{b}{v} \downarrow =$ $\quad \quad \quad \downarrow =$	
(4) Total				$\left. \begin{array}{l} (a) \uparrow \\ \text{or} \\ (b) \downarrow \end{array} \right\} \uparrow \uparrow =$	$\text{P.F.} = \frac{100 - \mu}{\mu} \times 1.5 =$	

# AVERAGE PERMEABILITY ( $\mu$ ) OF FORWARD END §

Passenger and Crew Spaces (a)† §§ or Other Spaces (b)‡					Whole Volume of Forward End	
Compartment (Reference letters as in B.H. 1)	Identification Measurements			Volume Cub. ft.	Longitudinal Error	Volume Cub. ft.
	Length	Breadth	Depth			
					Before Bulkhead No.....	
					(2) Total (v) =	
					$\mu = 63 + 35 \frac{a}{v} \uparrow =$ $\quad \quad \quad \uparrow \uparrow =$ $\text{or } 95 - 35 \frac{b}{v} \downarrow =$ $\quad \quad \quad \downarrow =$	
(5) Total				$\left. \begin{array}{l} (a) \uparrow \\ \text{or} \\ (b) \downarrow \end{array} \right\} \uparrow \uparrow =$	$\text{P.F.} = \frac{100 - \mu}{\mu} \times 1.5 =$	

† Applicable to ships of class I and ships of classes II and II(A) other than ships to which Part III of the Second Schedule applies.  
 § Applicable to ships of classes II and II(A) to which Part III of the Second Schedule applies.  
 §§ Delete parts not required.  
 ‡ In ships of classes III to VII inclusive, the average permeability ( $\mu$ ) is to be taken at 95.

AVERAGE PERMEABILITY (μ) OF MACHINERY SPACE§

Passenger and Crew Spaces (a) Cargo, Coal, or Stores (c)				Whole Volume of Machinery Space		
Compartments (Reference letters as in B.H. I)	Identification Measurements			Volume Cub. ft.	Longitudinal Extent	Volume Cub. ft.
	Length	Breadth	Depth			
					Between Bulkheads	
					Nos. ....	
					(3) Total (v) =	
					$\mu = 80 + 12.5 \frac{a-c}{v}$	<div>To be increased by 5 when ship is propelled by in- ternal combustion engines</div> ↑
					=	
				(6) Total (a) =		
				Volume (c) =	P.F. = $\frac{100 - \mu}{\mu} \times 1.5 =$	

VOLUMES FOR CRITERION NUMERAL\*

Permanent Oil Fuel Bunkers Before and Aft the Machinery Space

Compartments	Volume above inner bottom or Line of Floors Cub. ft.	Compartments	Volume above inner bottom or Line of Floors Cub. ft.
		Brought Forward	
Carried Forward		(7) Total =	

SUMMARY (For use on Page 1)\*

Whole Volume (V)		Machinery Space, &c. (M)		Passenger and Crew Spaces (P)	
	Cub. ft.		Cub. ft.		Cub. ft.
After End (1)		Machinery Space (3)		After End (4)	
Forward End (2)		Oil Fuel Bunkers (7)		Forward End (5)	
Machinery Space (3)				Machinery Space (6)	
Total (V) =		Total (M) =		Total (P) =	

† Applicable to all ships of classes I, II and II(A).

§ In ships of classes III to VI inclusive the average permeability (μ) is to be taken at 80 in steamships and at 85 in ships fitted with internal combustion engines.

\* Not applicable to ships referred to in Footnote §.



SHIPS OF CLASSES II AND II(A) TO WHICH PART III OF THE  
SECOND SCHEDULE TO CONSTRUCTION RULES APPLIES

CRITERION NUMERAL ( $C_s$ )

$C_s$  to be determined in accordance with the formula on page 1 except that

$$P_1 = \begin{cases} \text{No. of berthed passengers} \times .6L \text{ or } 125 \text{ whichever is greater} = & \text{cub. ft.} \\ \text{No. of unberthed passengers} \times 125 = & \text{cub. ft.} \end{cases}$$

FACTOR OF SUBDIVISION ( $F$ )

(1) Required Factor:—  $F = .50$  (or as determined by the formula stated on page 1 whichever is the less in the case of ships exceeding 450 feet in length)

Para. 9(1)

(2)  $L = 430$  ft. and upwards.

Factor from Curve A:—  $A = \frac{190}{L - 198} + .18 =$

Factor from Curve BB:—  $BB = \frac{57.6}{L - 108} =$

Required Factor:—  $F = A - \frac{(A - BB)(C_s - 23)}{100} =$

Para. 9(2)(a)

(3)  $L =$  Less than 430 ft. and not less than 180 ft. ( $C_s$  not less than  $S_1$ ).

$S_1 = \frac{1950 - 4L}{10} =$  Required Factor:—  $F = 1 - \frac{(1 - BB)(C_s - S_1)}{123 - S_1} =$

Para. 9(2)(b)

When  $C_s$  is less than  $S_1$  and in all ships less than 180 feet in length the subdivision is to be governed by the factor unity.

Para. 9(2)(c)

SHIPS OF CLASSES III TO VI INCLUSIVE—  
PART IV OF SECOND SCHEDULE TO CONSTRUCTION RULES

Subdivision Length  $L =$  feet

Required Factor:  $F$  to be stated .....

Para. 12

Details of any claim for local subdivision under para. 6(7) should be submitted with this form.

The paragraphs referred to above are those of the Second Schedule to the Construction Rules.

SURVEYOR'S REPORT

I have checked the builders' calculations required for the purpose of ascertaining the criterion numeral, factor of subdivision, permeabilities, etc., and am satisfied that the results shown on this form are correct.

Signature of Surveyor.....

Port.....

Date.....

FLOODING CALCULATION  
DIMENSIONS, COEFFICIENTS OF FORM, ETC.

Name of Ship..... Builders and No. of Ship..... G.N.L. No.....

Subdivision Length	(L) =	ft.	Freeboard Ratio	$\left(\frac{f}{d}\right) =$	Average Permeability (A) (B.H.2A.)
Subdivision Breadth	(B) =	"	Subdivision Draft	(d) =	
Moulded Depth	(D) =	"	Sheer of Margin Line Forward† (SF)	$\left(\frac{SF}{d}\right) =$	
Subdivision Depth	(d + D) =	"	Sheer of Margin Line Aft† (Sa)	$\left(\frac{Sa}{d}\right) =$	
Fall in Sheer (if any)	=	"	Criterion Numeral (B.H.2A.) (Ca)	(F) =	
Thickness of Bulkhead Deck	=	"			

Block Coefficient		Coefficient of Mean Waterplane		Degree of Flare { Forward aft } of Amidships =	ft. per cent. of L
*Volume of Displacement $\frac{L \times B \times d}{=}$	$\beta_1 = \frac{\text{Area}}{L \times B}$		Long. Momt. of Inertia $\frac{L^3 \times B}{=}$		

Sectional Area Coefficient ( $\beta_1$ ) =  $\frac{\text{Area of Section to corrected Margin Line}^*}{B \times d}$

Ordinate from After Perpendicular (per cent. of L):	0	10	15	20	30	40	50	60	70	80	85	90
Coefficient												

\* Inclusive of shaft bossing.  
† As corrected.  
Note.—For definitions, etc., see Construction Rules, Rule 1(2) and Part I of Second Schedule and Appendix II of the Instructions.

SURVEYOR'S REPORT

I have carefully checked the Builder's calculations and am satisfied that the particulars shown on this Form are correct.

SISTER SHIPS (IF ANY)

Name of Ship	Builders and No. of Ship	G.N.L. No.	C.M. No.

Signature of Ship Surveyor.....

Port .....

Date .....

FLOODING CALCULATION

FLOODABLE LENGTHS FOR SHIP OF STANDARD FORM (expressed as a percentage of the Length (L) of the Ship)

Name of Ship..... Builders and No. of Ship..... G.N.L. No.....

Ratios from B.H. 2	
Block Coefficient	= .....
Freeboard Ratio	= .....
Sheer Ratio Forward	= .....
Sheer Ratio Aft	= .....

For any permeability  $\mu$ , the permeability factor (P.F.) is given by  $1.5 \left( \frac{100 - \mu}{\mu} \right)$

The Floodable Lengths for  $\mu = 63$  may be taken as .95 of the Floodable Lengths for  $\mu = 60$ .

The Floodable Lengths for  $\mu = 95$  may be taken as 1.06 of the Floodable Lengths for  $\mu = 100$ .

Distance of Ordinate from the after Perpendicular	Floodable Lengths from Cross Curves†		Col. (2) — Col. (1)	After End		Machinery Space		Forward End	
				$\mu =$	P.F. =	$\mu =$	P.F. =	$\mu =$	P.F. =
	$\mu = 100$	$\mu = 60$		Col. (3) x P.F.	Floodable Length Col. (4) + Col. (1)	Col. (3) x P.F.	Floodable Length Col. (6) + Col. (1)	Col. (3) x P.F.	Floodable Length Col. (8) + Col. (1)
Per cent. of L	(1)	(2)	(3)	(4)*	(5)*	(6)*	(7)*	(8)*	(9)*
A.T.									
15									
20									
30									
40									
45									
50									
60									
70									
80									
85									
F.T.									

\* In filling in these columns, omissions will be found possible outside the spaces concerned.  
† See Standard Diagrams of Floodable Lengths, etc.

Calculations by.....  
Checked by.....  
Date.....

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FLOODING CALCULATION

CORRECTED FLOODABLE AND PERMISSIBLE LENGTHS FOR SHIP

Name of Ship..... Builders and No. of Ship..... G.N.L. No.....

Coefficients of Mean Waterplane		Constants
Ratios, etc. (from B.H. 2 and B.H. 2A)	For Standard Form (from Cross Curves)	For Ship (from B.H. 2)
Block Coefficient = .....	$\beta =$ .....	$\beta_1 =$ .....
Freeboard Ratio = .....	Centre of Flotation Aft { Before	Centre of Flotation { Before
Shear Ratio Forward = .....	Amidships (per cent. of L.) = .....	Amidships (per cent. of L.) = .....
Shear Ratio Aft = .....	Centre of Flotation of Ship { Before	that of Standard Form (per cent. of L.) = .....
Factor of Subdivision (F) = .....	$m =$ .....	$m = 100m.$

For Standard Form				Forward and After Ends					Machinery Space									
Distance of Ordinate from Centre of Flotation $(\bar{x})$	Values of $p =$ Col. (2) + 100	Sectional Area Coefficient from Cross Curves $\beta$	*Values of $1 \pm \left(\frac{m}{n} \times p\right)$	$\frac{n_1}{n} \times \frac{a}{a_1}$ divided by Figures in Col. (5)	Distance of New Ordinates from Centre of Flotation of Ship $(\bar{x}_1)$ Col. (2) $\times$ Col. (6)	Distance of New Ordinates from Amidships	Sectional Area Coefficient for Ship at New Ordinates $\beta_1$	Form Correction Factor = Col. (5) $\times \frac{\beta}{a} \times \frac{\beta_1}{\beta_1}$	Standard Form	Ship		†† 90% Floodable Lengths						
										Floodable Lengths at New Ordinates	Permissible Lengths at New Ordinates							
(1)‡	(2)‡	(3)	(4)	(5)	(6)	(7)‡	(8)‡	(9)	(10)	(11)‡	Col. (11) $\times$ Col. (10)	Col. (12) $\times$ Col. (10)	Col. (13) $\times$ Col. (10)	Col. (14) $\times$ Col. (10)	Col. (15) $\times$ Col. (10)	Col. (16) $\times$ Col. (10)	Col. (17) $\times$ Col. (10)	Col. (18) $\times$ Col. (10)
Distance of Ordinate from A.P.	A.T.																	
	15																	
	20																	
	30																	
	40																	
	45																	
	50																	
	60																	
	70																	
	80																	
	85																	
	F.T.																	

\* When the centre of Flotation of Ship is { Before } that of Standard Form, the (±) sign is taken for the Fore Body and the (∓) sign for the After Body. Calculations by.....

† Obtained from Curve of Coefficients ( $\beta_1$ ) drawn from particulars given in B.H. 2

†† For use when bulkheads are "stepped".

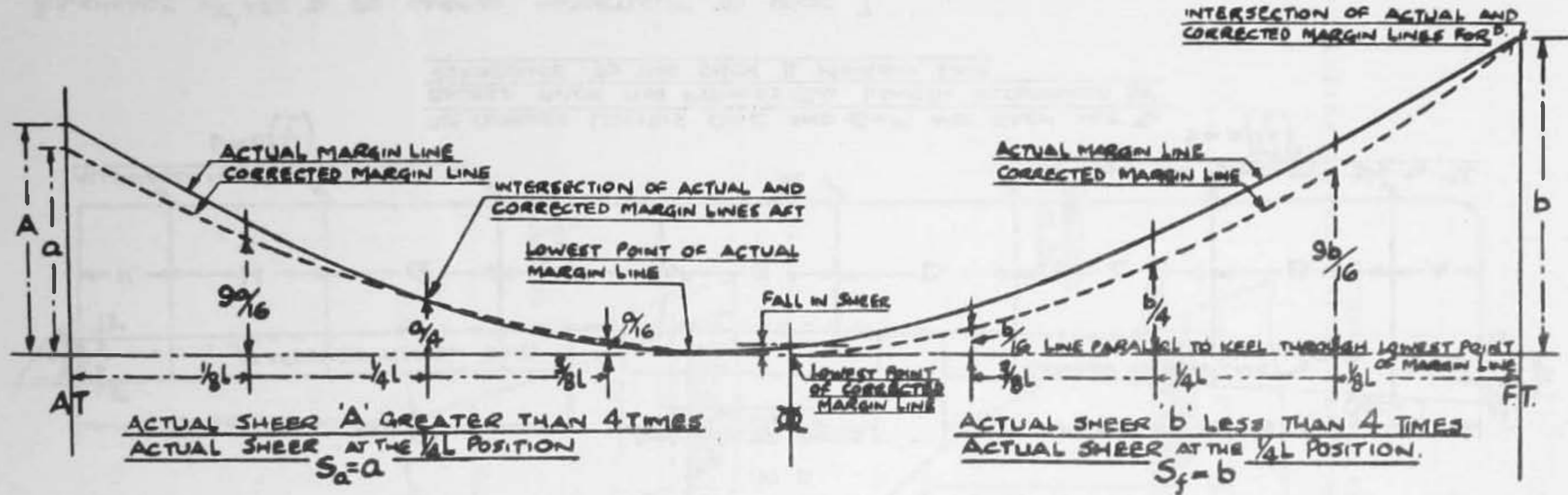
‡ See Standard Diagrams of Floodable Lengths, etc.

‡ Percentage of Length (L.) of Ship.

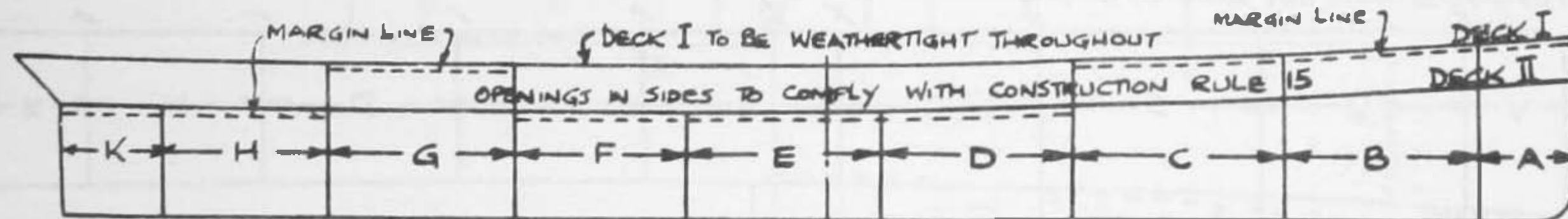
Checked by.....

Date.....

MAROIN LINE  
TO ILLUSTRATE THE "NOTES" TO APPENDIX II OF THESE INSTRUCTIONS  
FIG. A



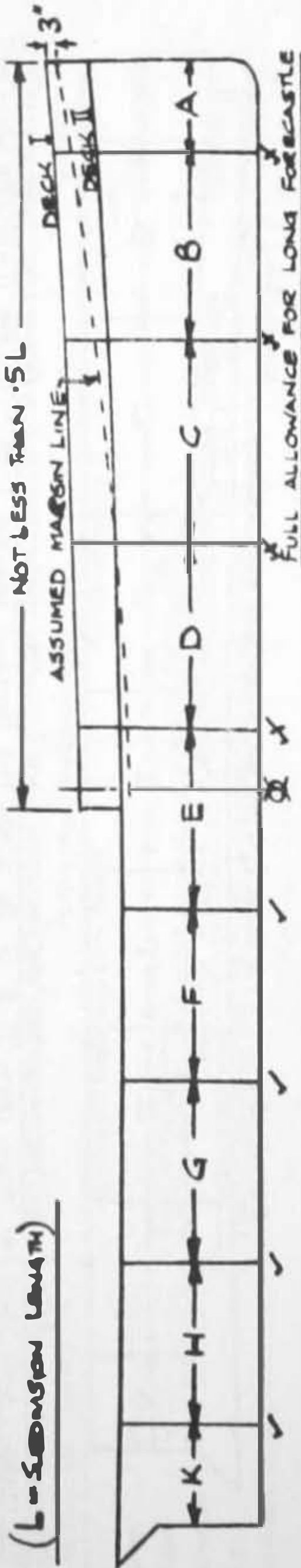
MAROIN LINES IN SPECIAL CASES  
PARA. 6(1)(d) OF SECOND SCHEDULE TO CONSTRUCTION RULES  
FIG. B



FOR COMPARTMENTS A, B, C AND G THE MARGIN LINE DERIVED FROM DECK I MAY BE USED. FOR THE REMAINING COMPARTMENTS THE MARGIN LINE DERIVED FROM DECK II IS TO BE USED. THE COMBINED LENGTHS C+D, F+G, AND G+H ARE EACH NOT TO EXCEED TWICE THE PERMISSIBLE LENGTH DETERMINED BY REFERENCE TO THE DECK II MARGIN LINE.

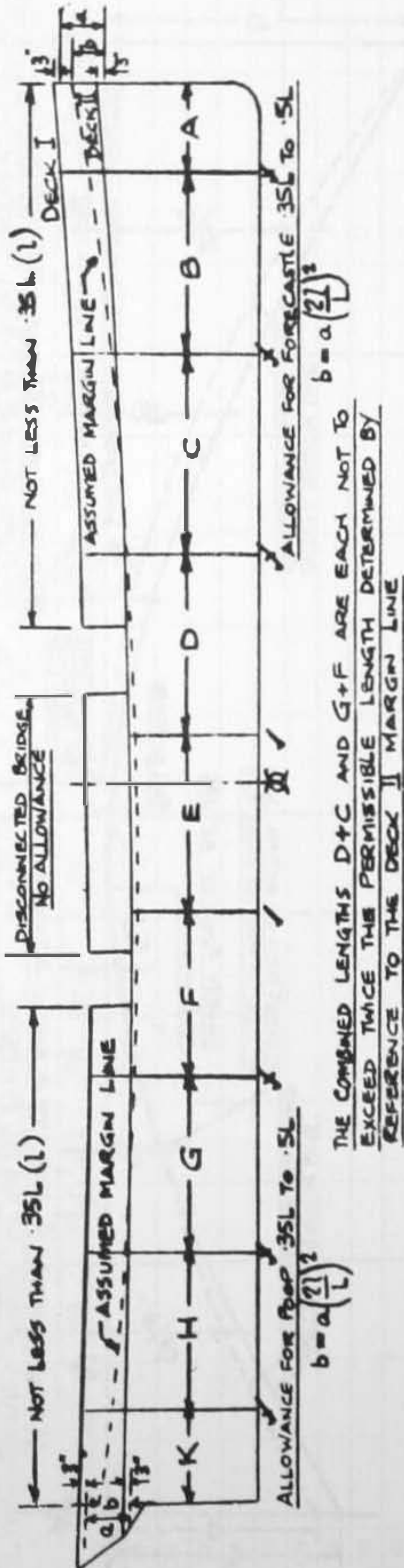
MARGIN LINES IN SPECIAL CASES  
PARA. 96(2)(b) OF THESE INSTRUCTIONS

FIG. C



FOR COMPARTMENTS A, B, C AND D THE ASSUMED MARGIN LINE AS INDICATED MAY BE USED, FOR THE REMAINING COMPARTMENTS THE MARGIN LINE WILL BE THAT DERIVED FROM DECK II. THE COMBINED LENGTH OF D AND E IS NOT TO EXCEED TWICE THE PERMISSIBLE LENGTH DETERMINED BY REFERENCE TO THE DECK II MARGIN LINE

FIG. D



THE COMBINED LENGTHS D+C AND G+F ARE EACH NOT TO EXCEED TWICE THE PERMISSIBLE LENGTH DETERMINED BY REFERENCE TO THE DECK II MARGIN LINE

BULKHEADS ✓ ARE TO BE CARRIED WATERTIGHT TO DECK I  
BULKHEADS ✓ ARE TO BE CARRIED WATERTIGHT TO DECK II  
WHERE HOWEVER THE ASSUMED MARGIN LINE IS APPRECIABLY BELOW DECK I THE MINISTRY MAY PERMIT  
A LIMITED RELAXATION IN THE WATERTIGHTNESS OF THOSE PORTIONS OF THE BULKHEADS WHICH ARE  
ABOVE THE ASSUMED MARGIN LINE AND IMMEDIATELY UNDER DECK I.



**FIG. 8**  
**RECESSES IN W.T. BULKHEADS**  
**TO ILLUSTRATE PARA. 6(4) OF SECOND SCHEDULE TO CONSTRUCTION RULES**

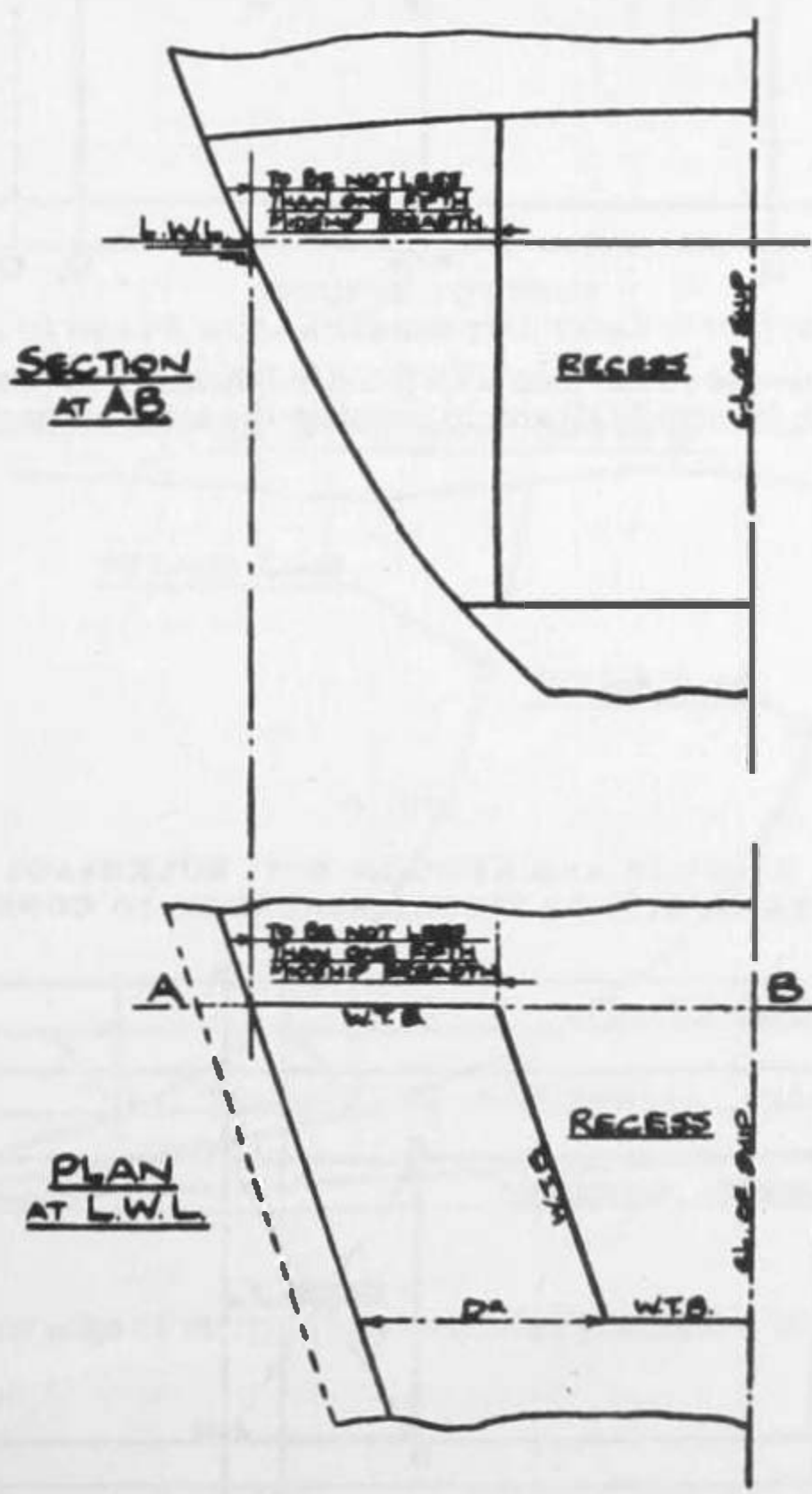
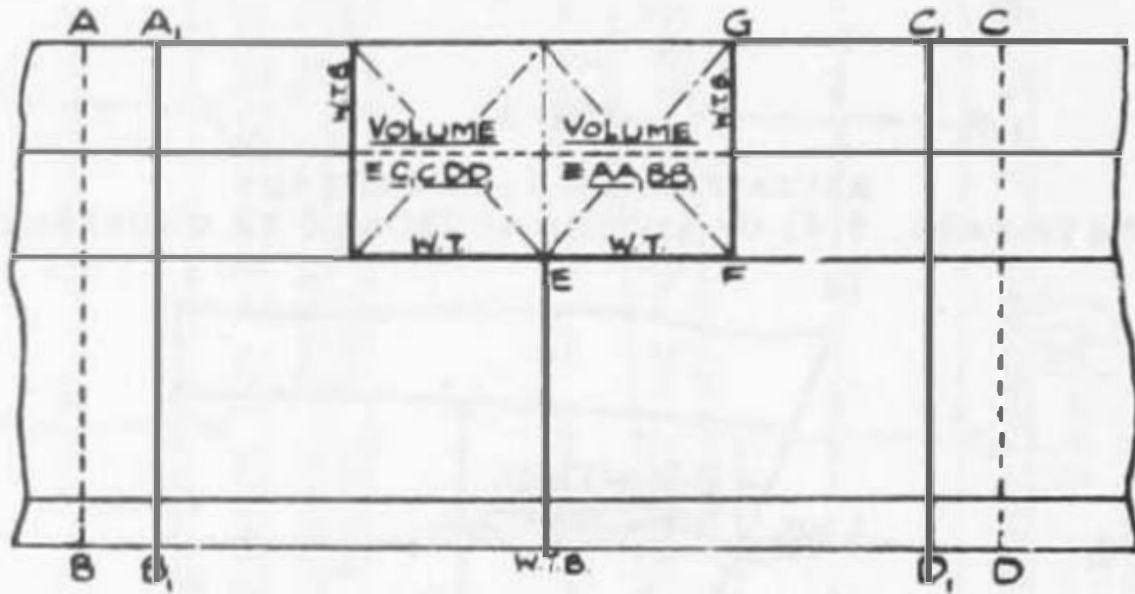


FIG. F

STEPS IN W.T. BULKHEADS  
TO ILLUSTRATE PARA. 6(3)(ii) OF SECOND SCHEDULE TO CONSTRUCTION RULES

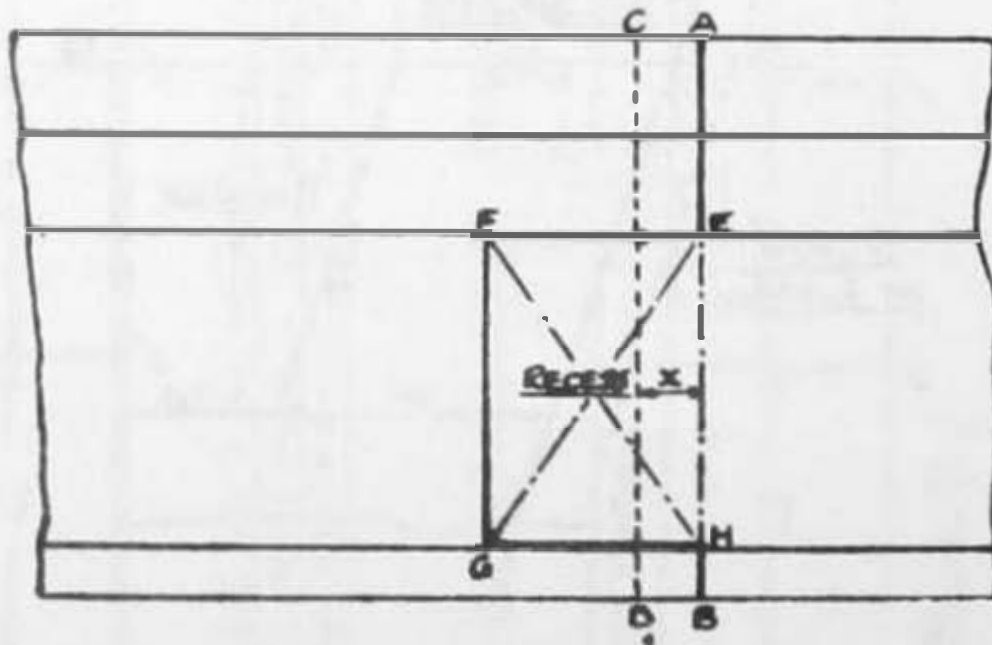


ELEVATION

Dotted lines show transverse subdivision with plane bulkheads. Full lines show arrangement to compensate for step EGF and to maintain the same measure of safety.

FIG. G

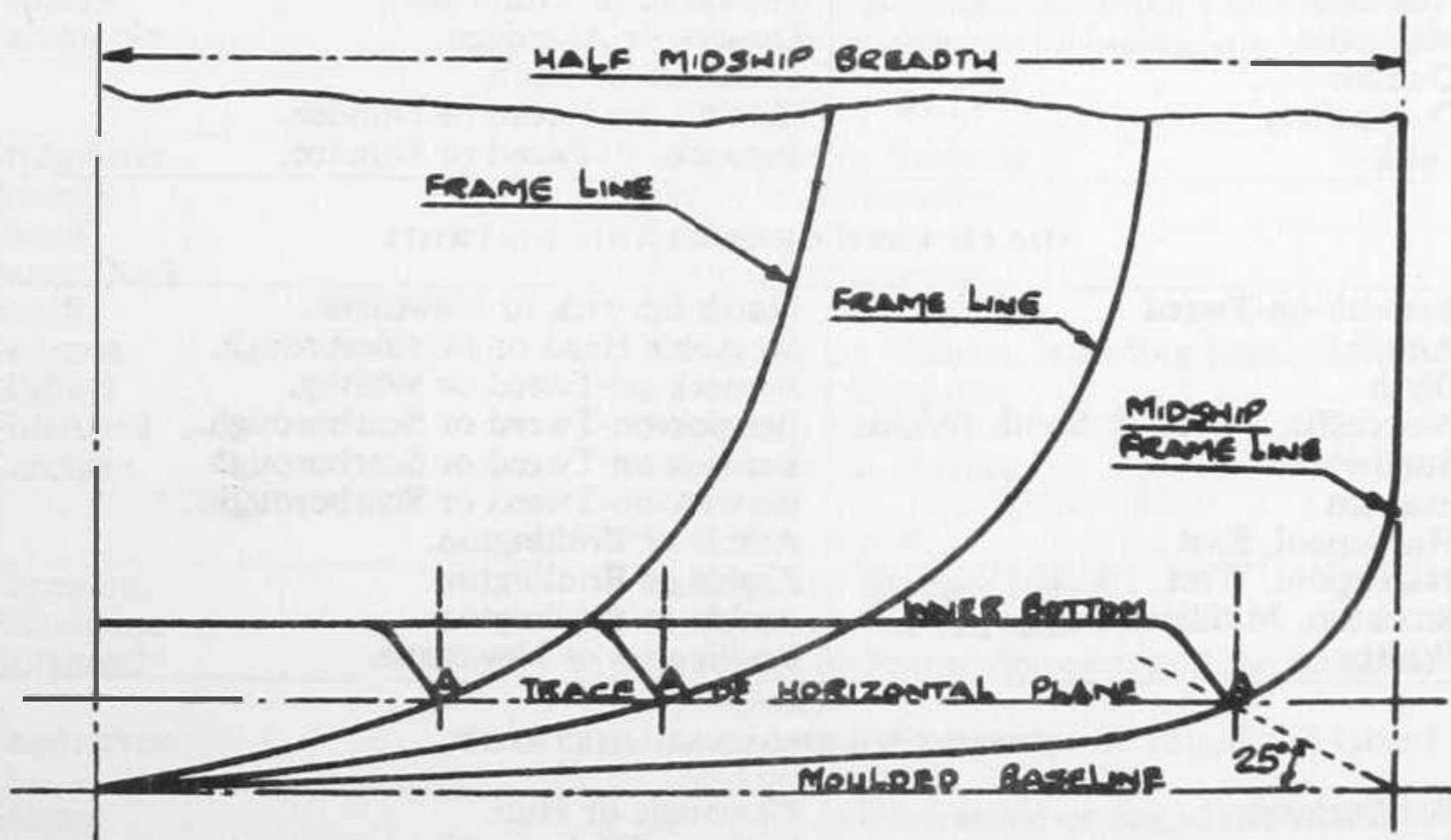
RECESSES AND STEPS IN W.T. BULKHEADS  
TO ILLUSTRATE PARA. 6(5) OF SECOND SCHEDULE TO CONSTRUCTION RULES



ELEVATION

Bulkhead AB is recessed as shown in sketch. The Position of the Equivalent plane bulkhead is given by  $x = \text{volume FH of recess} \div "A"$ , where "A" is the sectional area to margin line approximately midway between AB and CD.

FIG. H  
DOUBLE BOTTOMS  
TO ILLUSTRATE RULE 7(2) OF THE CONSTRUCTION RULES



Intersection of outer edge of margin plate with bilge plating not to be lower than AAA.



## APPENDIX III

### List of Class III Plying Limits

(SEE PART I PARAGRAPH 18 AND ALSO RULE 2(1) OF THE RULES)

#### EAST OF SCOTLAND DISTRICT

Name of Port	
Cromarty . . . . .	From Cromarty along the coast to Lossiemouth or Dunrobin.
Inverness . . . . .	Lossiemouth or Dunrobin.
Banff . . . . .	Peterhead or Lossiemouth
Peterhead . . . . .	Aberdeen or Banff.
Aberdeen . . . . .	Peterhead or Montrose.
Montrose . . . . .	Dundee or Aberdeen.
Dundee . . . . .	Montrose or Leith.
Queensferry . . . . .	Berwick-on-Tweed or Dundee.
Leith . . . . .	Berwick-on-Tweed or Dundee.

#### NORTH EAST OF ENGLAND DISTRICT

Berwick-on-Tweed . . . . .	North Berwick or Newcastle.
Amble . . . . .	St. Abb's Head or Middlesbrough.
Blyth . . . . .	Berwick-on-Tweed or Whitby.
Newcastle, North & South Shields	Berwick-on-Tweed or Scarborough.
Sunderland . . . . .	Berwick-on-Tweed or Scarborough.
Seaham . . . . .	Berwick-on-Tweed or Scarborough.
Hartlepool, East . . . . .	Amble or Bridlington.
Hartlepool, West. . . . .	Amble or Bridlington.
Stockton, Middlesbrough . . . . .	Amble or Bridlington
Whitby . . . . .	Bridlington or Newcastle.

#### EAST OF ENGLAND DISTRICT

Scarborough . . . . .	Newcastle or Hull.
Hull . . . . .	Lynn or Scarborough.
Goole . . . . .	Lynn or Scarborough .
Gainsborough. Lincoln, Notting- ham, York . . . . .	Spurn Point or Donna Nook.
Grimsby . . . . .	Lynn or Scarborough.
Boston . . . . .	Cromer or Hull.
Bridlington . . . . .	West Hartlepool or Hull.

#### LONDON DISTRICT

Wisbech . . . . .	Cromer or Hull.
King's Lynn . . . . .	Cromer or Hull
Yarmouth and Lowestoft . . . . .	Cromer or Walton-on-the-Naze.
Harwich, Ipswich, or Felixstowe Railway Pier . . . . .	London or Yarmouth.
Burnham-on-Crouch . . . . .	London or Felixstowe
London . . . . .	Dover or Felixstowe.
Rochester . . . . .	Dover or Felixstowe.
Dover . . . . .	Newhaven or Sheerness.
Folkestone . . . . .	Newhaven or Sheerness.
Newhaven . . . . .	Portsmouth or Dover.
Littlehampton . . . . .	Pool or Rye.

# **SOUTH AND SOUTH WEST OF ENGLAND DISTRICT**

Name of Port	
Portsmouth . . . . .	Newhaven or Weymouth.
Southampton . . . . .	Newhaven or Weymouth.
Poole . . . . .	Weymouth or The Nab.
Weymouth . . . . .	Portsmouth or Dartmouth.
Exeter . . . . .	Weymouth or Plymouth.
Teignmouth . . . . .	Weymouth or Plymouth.
Torquay . . . . .	Weymouth or Fowey.
Dartmouth . . . . .	Weymouth or Plymouth.
Plymouth . . . . .	Exeter or the Lizard.
Fowey . . . . .	Falmouth or Torquay.
Par . . . . .	Falmouth or Plymouth.
Falmouth . . . . .	Start Point or Penzance.
Penzance . . . . .	Falmouth or St. Ives.
St. Ives . . . . .	Padstow or Penzance.
Padstow . . . . .	St. Ives or Barnstaple including Lundy Island.
Barnstaple . . . . .	Padstow or Bridgwater including Lundy Island.

## **BRISTOL CHANNEL DISTRICT**

Bridgwater . . . . .	Ilfracombe or Swansea.
Bristol . . . . .	Tenby or Ilfracombe.
Cardiff . . . . .	Tenby or Ilfracombe.
Barry Dock . . . . .	Tenby or Ilfracombe.
Neath . . . . .	Barnstaple or Milford.
Swansea . . . . .	Barnstaple or Milford, including Lundy Island.
Milford . . . . .	Swansea or Cardigan.
Fishguard . . . . .	Barmouth or Tenby.
Cardigan . . . . .	Portmadoc or Milford.

## **LIVERPOOL DISTRICT**

Barmouth . . . . .	Cardigan or Bardsey Island.
Portmadoc . . . . .	Cardigan or Caernarvon.
Holyhead . . . . .	Liverpool or Portmadoc or round the Island of Anglesey.
Caernarvon . . . . .	Llandudno or Portmadoc or round the Island of Anglesey.
Bangor . . . . .	Liverpool or Portmadoc or round the Island of Anglesey.
Conway . . . . .	Liverpool or Holyhead or through Menai Straits to Portmadoc.
Chester . . . . .	Barrow or Holyhead or Menai Bridge.
Liverpool . . . . .	Barrow or Holyhead or Menai Bridge.
Blackpool . . . . .	Whitehaven or Llandudno.
Fleetwood . . . . .	Whitehaven or Llandudno.
Lancaster . . . . .	Whitehaven or Llandudno.
Heysham . . . . .	Whitehaven or Llandudno.
Morecambe . . . . .	Whitehaven or Llandudno.
Barrow . . . . .	Whitehaven or Llandudno.
Douglas . . . . .	Round the Island.
Whitehaven . . . . .	Silloth or Blackpool.

## **WEST OF SCOTLAND DISTRICT**

Dumfries . . . . .	Wigtown or Whitehaven.
Wigtown . . . . .	Stranraer or Dumfries.
Stranraer . . . . .	Wigtown or Greenock, along the West Coast of the Mainland.
Ayr . . . . .	Within a line from Campbeltown to Turnberry Point and from Turnberry Point to Stranraer along the West Coast of the Mainland.

Ardrossan	Within a line from Campbeltown to Turnberry Point and from Turnberry Point to Stranraer along the West Coast of the Mainland.
Glasgow	Within a line from Campbeltown to Turnberry Point and from Turnberry Point to Stranraer along the West Coast of the Mainland.
Campbeltown	Within a line from Campbeltown to Turnberry Point and from Turnberry Point to Stranraer along the West Coast of the Mainland.
Oban	Crinan, Tobermory or Fort William.
Fort William	Crinan or Tobermory.
Kyle of Lochalsh	Portree and Loch Gairloch or to Mallaig and Loch Scavaig.
West Loch, Tarbert	Lowlandman Bay, Island of Jura, or Port Ellen, or Port Askaig, Island of Islay.

NORTHERN IRELAND DISTRICT

Belfast	Rathlin Island or Killough.
Carlingford Lough	Drogheda or Strangford Lough.
Londonderry	Buncrana in Lough Swilly or Rathlin Island.



# APPENDIX IV

(SEE PARAGRAPHS 29 AND 48)

## SAFETY CERTIFICATE

(Official Seal)

(Country

an  
for ——— international voyage  
a short

Issued under the provisions of the

*International Convention for the Safety of Life at Sea, 1948*

Name of Ship	Distinctive Number or Letters	Port of Registry	Gross Tonnage	Particulars of voyages, if any, sanctioned under Regulation 22(c) of Chapter III

The

(Name) Government certifies

I, the undersigned,

(Name) certify

I. That the above-mentioned ship has been duly surveyed in accordance with the provisions of the Convention referred to above.

II. That the survey showed that the ship complied with the requirements of the Regulations annexed to the said Convention as regards:

- (1) the structure, main and auxiliary boilers and machinery;
- (2) the watertight subdivision arrangements and details;
- (3) the following subdivision loadlines:

Subdivision loadlines assigned and marked on the ship's side at amidships (Regulation 10 of Chapter II)	Freeboard	To apply when the spaces in which passengers are carried include the following alternative spaces
C.1	.....	.....
C.2	.....	.....
C.3	.....	.....

III. That the life-saving appliances provide for a total number of ..... persons and no more, viz.:

- .....lifeboats (including ..... motor lifeboats or mechanically propelled lifeboats) capable of accommodating .....persons, and ..... motor lifeboats fitted with radiotelegraph installation and searchlight (included in the total lifeboats shown above), requiring ..... certificated lifeboatmen;
- ..... liferafts capable of accommodating ..... persons;
- ..... buoyant apparatus capable of supporting ..... persons;
- ..... lifebuoys;
- ..... lifejackets.

IV. That the lifeboats were equipped in accordance with provisions of the Regulations.

V. That the ship was provided with a line-throwing appliance and lifeboat portable radio apparatus in accordance with the provisions of the Regulations.

VI. That the ship complied with the requirements of the Regulations as regards radiotelegraph installations, viz:

	Requirements of Regulation	Actual provision
Hours of listening by operator . . . . .	.....	.....
Number of operators . . . . .	.....	.....
Whether auto-alarm fitted . . . . .	.....	.....
Whether main installation fitted . . . . .	.....	.....
Whether emergency installation fitted . . . . .	.....	.....
Whether main and emergency transmitters elec- trically separated or combined . . . . .	.....	.....
Whether direction-finder fitted . . . . .	.....	.....
Number of passengers for which certificated . . . . .	.....	.....

VII. That the ship complied with the requirements of the Regulations, as regards fire-detecting and fire-extinguishing appliances and was provided with navigation lights and shapes, and means of making sound signals and distress signals, in accordance with the provisions of the Regulations and also the International Collision Regulations.

VIII. That in all other respects the ship complied with the requirements of the Regulations, so far as these requirements apply thereto.

This certificate is issued under the authority of the Government.  
It will remain in force until

Issued at the day of 19

Here follows the seal or signature of the authority entitled to issue the certificate.  
(Seal)

If signed, the following paragraph is to be added:

The undersigned declares that he is duly authorised by the said Government to issue this Certificate.  
(Signature)

EXEMPTION CERTIFICATE

(Official Seal) (Country)

Issued under the provisions of the  
International Convention for the Safety of Life at Sea, 1948

Name of Ship	Distinctive Number or Letters	Port of Registry	Gross Tonnage

The (Name) Government certifies  
I, the undersigned, (Name) certify

That the above-mentioned ship is, under the authority conferred by Regulation  
..... of Chapter ..... of the Regulations annexed to the Convention

referred to above, exempted from the requirements of†.....  
of the Convention on the voyages.....  
to .....

• Insert here the conditions, if any, on which } •  
the exemption certificate is granted.

This certificate is issued under the authority of the Government.  
It will remain in force until

Issued at the day of 19  
Here follows the seal or signature of the authority entitled to issue this certificate.  
(Seal)

If signed, the following paragraph is to be added:

The undersigned declares that he is duly authorised by the said Government to  
issue this Certificate.

(Signature)

† Insert here references to Chapters and Regulations, specifying particular paragraphs.



## APPENDIX V

### Miscellaneous Surveys and Inspections

---

1. *General.* For the convenience of shipowners, shipbuilders, steelmakers and makers of equipment for ships, surveys and inspections may be carried out by the Ministry's surveyors for the issue of the following certificates:

- (a) Certificate of Survey.
- (b) Certificate of Examination of Plans and Designs.
- (c) Certificate of Inspection and Tests.
- (d) Certificate of Tests of Material.
- (e) Certificate of Inspection (Testing Machines).

Although the procedure outlined in this Appendix refers primarily to the survey of passenger ships, Certificates of Examination of Plans and Designs or of Inspection and Tests may also be issued in respect of life-saving appliances, fire appliances, and similar equipment required on ships for the purposes of the respective Statutory Rules.

2. *Fees.* The fees chargeable for the foregoing services and for the issue of the appropriate certificates are given in the "List of Fees and Expenses payable in connection with Marine Surveys and other Mercantile Marine Services" (obtainable from H.M.S.O.).

#### CERTIFICATE OF SURVEY

3. This type of certificate may cover the survey or partial survey during construction of a ship which for various reasons will not qualify for a passenger certificate or a passenger and safety certificate, e.g. where the ship will not be trading to, from or between United Kingdom ports, where passenger accommodation is not fitted or where the Rules and instructions relating to the hull, equipments or machinery are not fully complied with. After such survey or partial survey (which may include steam trials) the Ministry will issue a Certificate of Survey certifying that the hull, equipments and machinery of the ship have (with specified exceptions, if appropriate) been constructed to the satisfaction of the Surveyor and that (but for the exceptions specified) the ship would have been entitled to a passenger certificate or passenger and safety certificate under the Merchant Shipping Acts.

The procedure for these surveys should be the same as that followed in the survey for the issue of a passenger certificate or passenger and safety certificate.

A Certificate of Survey may also be issued in respect of a passenger ship to be engaged in special trades in the Far East, if the Ministry's Surveyors are satisfied that the ship meets the requirements of the Simla Rules.

On completion of the survey the Surveyor should forward with his report to headquarters a declaration for the parts he has actually surveyed, stating the period for which they are in his opinion fit and giving the name and address of the applicant to whom the Certificate of Survey is to be sent.

#### CERTIFICATE OF EXAMINATION OF PLANS AND DESIGNS

4. Where a ship is not to be surveyed by the Ministry's Surveyors for the issue of a passenger certificate or passenger and safety certificate during construction the plans may be examined for the issue of a Certificate of Examination of Plans and Designs. This applies to ships which are to be built either in the United Kingdom or abroad for British or foreign owners. The Chief Ship Surveyor and the Engineer Surveyor-in-Chief will examine and advise upon any plans showing the proposed hull scantlings, watertight subdivision, fire protection, machinery and boilers and other arrangements and details. Where the final proposals comply with the Ministry's requirements for passenger ships a Certificate of Examination of Plans and Designs will be issued.

Examination of designs of fittings proposed to be accepted as standards in connection with watertight subdivision, fire protection, machinery, and other arrangements will also be undertaken and if required a Certificate of Examination of Plans and Designs will be issued.

## CERTIFICATE OF INSPECTION AND TESTS


5. *General.* Inspection and tests of fittings and appliances submitted for approval as standards in connection with watertight subdivision, fire protection, machinery and other arrangements of ships will be undertaken and, if required, a Certificate of Inspection and Tests of the prototype will be issued.

Inspection and tests of boilers, machinery, and other items intended for particular ships will also be undertaken and a Certificate of Inspection and Tests issued where the design, material and workmanship are satisfactory.

The Surveyor should be guided by the relevant Instructions, supplemented in the case of fittings for use on particular ships by paragraphs 6–12 of this Appendix.

6. *Procedure and Reports.* A copy of the order for the parts for which a certificate is desired should be forwarded by the makers to the local Ministry Surveyors. Unless the parts are to be made to an accepted standard design, fully dimensioned detailed drawings of the items are to be submitted to headquarters. The Surveyor should witness material and/or hydraulic tests and inspect the parts during construction.

On completion of the survey the Surveyor should forward to headquarters, with the relevant papers, a report including the particulars necessary for the certificate to be prepared, the identification marks stamped on the parts inspected and the name and address of the firm to whom the certificate is to be issued.

7. *Stamping.* On satisfactory completion of inspection and tests all articles should be stamped M.  T., the date, and the Surveyor's initials, with the exception of pipes and tubes up to and including 4 inches diameter.

Additional particulars should be stamped as necessary to comply with the following paragraphs of the Instructions:

112(1) Watertight doors

247(j) Boilers

325(b) Evaporators, Heaters, Filters, Distillers, etc.

342(g) Air receivers

343(g) Air bottles

Other items which are hydraulically tested should be stamped accordingly.

Furnaces should each be stamped on the inside of the lower part near the mouth. The stamping should include the identification number and the tensile strength and elongation of the plate.

All pipes and tubes up to and including 4 inches diameter should be stamped with consecutive numbers and with the Surveyor's initials and if any pipe or tube is cut into shorter lengths each length should be marked in the same way as the original tube. Where, in the Surveyor's opinion, it is not practicable to stamp pipes and tubes the stamping may be made on metal wired-on labels.

8. *Furnaces.* In the construction of furnaces for which a certificate is required each plate used should be tested in the presence of one of the Ministry's Surveyors; stock plates of suitable quality, which have been tested and approved, may be used for the purpose. The Surveyor should examine each completed furnace and gauge it for circularity and as far as possible for thickness.

9. *Tubes subject to External Pressure.* The Surveyor should witness a hydraulic test of each tube to three times the working pressure and the following additional tests should be made:

(a) *Iron Tubes and solid-drawn Steel Tubes.* Bend tests should be made from the scrap ends of 3 per cent. of the tubes and drift tests from a similar number of the finished tubes.

(b) *Lap-welded Steel Tubes.* Bend tests should be made from 20 per cent. of the strips from which the tubes are made and drift tests from 5 per cent. of the finished tubes.

(c) *Lap-welded Stay Tubes.* Drift tests should be made from 5 per cent. of the scrap ends of the finished tubes.

The minimum increase in the diameter due to drifting should be  $\frac{1}{16}$ " per inch in the case of iron tubes and  $\frac{1}{8}$ " per inch in the case of steel tubes and pipes.

10. *Tubes subject to Internal Pressure.* The tubes and pipes should be tested in accordance with the relative Instructions. Where the applicant wishes the results of the tests of the material to be included in the certificate the case will be dealt with on a Certificate of Tests of Material (see paragraphs 13-16 of this Appendix).

11. *Propeller Shafts.* In the case of a propeller shaft fitted with a liner, the shaft is to be examined after it has been machined and before the liner has been put in place and it should be seen that the liner is properly shrunk or forced on to the shaft.

12. *Distilling Apparatus.* In addition to the hydraulic tests specified in paragraph 325 of these Instructions, the test on the filter should not be less than four-fifths of the maximum pressure permitted in the coils.

It should be understood that the certificate will refer merely to the design and sufficiency of the distiller for working at the pressure stated and that before the apparatus is finally passed for use on a ship it will be tested for efficiency and for the quantity and quality of the water produced.

## CERTIFICATE OF TESTS OF MATERIAL

13. *General.* The following provisions, which supplement the requirements of Chapter 2 of Part VI of these Instructions, relate to the testing of material for boilers and machinery for which certified copies of the results of tests witnessed by the Surveyor are required. In certain cases they also relate, with appropriate modifications, to the testing of material for the hull (see Chapter 2 of Part II of these Instructions).

The makers must certify that the tensile and cold bend test pieces were tested in the condition—normal, annealed or otherwise heat treated—in which the material was delivered from their works. Their certificate should take one of the following forms, according to the circumstances.

**(a) In the case of material tested in the normal condition:**

"We hereby certify that the material described above was delivered by us in the normal condition and that the samples cut therefrom and tested by us in the presence of your surveyor, Mr. .... on the ..... were in the same condition."

## Works Manager.

**(b) In the case of material tested in the annealed or other heat treated condition:**

"We hereby certify that the material described above was delivered by us in the annealed condition and that the samples cut therefrom and tested by us in the presence of your Surveyor, Mr. .... on the ..... were in the same condition, and that the treatment adopted was applied simultaneously to the articles and to their test pieces."

## Works Manager.

14. *Number of tests.* The number of tests specified in each case mentioned below is to be regarded as the minimum number of tests to be witnessed by the Surveyor and, if he has good cause, he may require the number to be increased.

**Section, Rivet and Stay Bars.** Tensile tests should be made from bars of each diameter or section rolled from each charge in accordance with the following table and bending tests should be made from section and stay bars in the same proportions. No bend tests need be made from rivet bars.



	Number of bars from one charge	Number of Tests
Sections all sizes, and bars over 1½ inches diameter	4 or less . . . . .	1
	5 to 15 . . . . .	2
	For each additional 8 or part thereof . . . . .	add 1
Bars 1½ inches diameter and under	10 or less . . . . .	1
	11 to 50 . . . . .	2
	For each additional 25 or part thereof . . . . .	add 1

**Rivets.** In addition to the tensile tests required from the rivet bars, check tensile tests and a number of cold bending and hot flattening tests from rivets of each size should be made. If the results of the bar and rivet tests are satisfactory, a formal certificate will be required from the rivet makers stating that the material used for any parcels of rivets sent out to fulfil a particular order has been tested in the presence of the Ministry's Surveyors and approved.

15. *Stamping Material.* With the exception of rivets, the material for delivery should be stamped with an identification number and the Surveyor's initials. All plates and those bars which have been tested should also be stamped with figures denoting the tensile strength and elongation. A letter, instead of a number, may be stamped on round bars 1 inch or less in diameter. If a plate or bar is cut into separate portions each portion should be stamped in the same way as the original plate or bar.

These identification marks should be inspected by the Surveyor who should see that they correspond with the results and other particulars reported.

16. *Reporting Results of Tests, etc.* The surveyor who witnesses the tests should forward to the Engineer Surveyor-in-Chief (or to the Chief Ship Surveyor in the case of materials for the hull) the form Surveys 24 showing the test results and identification marks, together with a copy of the order for the material and the makers' certificate, or certificates, as indicated in paragraph 13. In reporting, he should make it clear that all the Ministry's requirements applicable to the case have been complied with, and state the name and address of the firm who ordered the material and of the firm to whom the Certificate of Tests of Material is to be sent.

#### TESTING OF MATERIAL FOR STOCK

17. *General.* For the convenience of shipbuilders, ship repairers, engine builders, boiler makers, etc., in the United Kingdom, Surveyors may witness tests of material intended for stock. Such material will generally be in the form of steel plates, steel bars, boiler tubes, steel pressure pipes and bronze shafting. The Surveyor should refer to the relevant paragraphs of the Instructions for guidance on testing procedure except that the numbers of tests for bars are to be as given in paragraph 14 above.

If a certificate is required the case should be dealt with as outlined in this Appendix for "Certificate of Inspection and Tests" or "Certificate of Tests of Material"; otherwise the following procedure should be adopted.

18. *Stamping.* With the exception of rivets, the material should be stamped with an identification number and the Surveyor's initials. A letter, instead of a number, may be stamped on round bars 1 inch or less in diameter. If a plate or bar is cut into separate portions each portion should be stamped in the same way as the original plate or bar.

19. *Reporting results of Tests.* The Surveyor who witnesses the tests should record the results and identification marks on Form Surveys 24. When the test results have been approved, the form should be filed in the office records unless the material is for stock outside the district in which it is made. In that case, the Form Surveys 24 should be sent to the district in which the material is to be stocked and a copy retained for record.

20. *Fees.* Fees should be charged as indicated in the "List of Fees and Expenses payable in connection with Marine Surveys and other Mercantile Marine Services".

#### 21. *Rivets for Boilers and Unfired Pressure Vessels*

Special arrangements have been made for acceptance of rivets made by:

The Rivet, Bolt and Nut Company, Coalbridge and Gateshead-on-Tyne.

North-West Rivet, Bolt and Nut Factory, Ltd., Airdrie.

Cooper and Turner, Ltd., Sheffield.

Gladstone Ltd., Stockton-on-Tees.

The rivets should be made from bars manufactured by approved steel makers. Bars from rivet makers' stock may be accepted without prior testing at the steel works subject to production of the steel maker's certificate giving the process by which the steel was made, the charge number, and cast analysis. All rivet bars should, however, be inspected and tests should be witnessed, by the Ministry's Surveyors, either at the steel makers' or rivet makers' works.

Notification of an order for rivets for boilers or pressure vessels under the Ministry's survey should be given on Form A by the rivet makers to the Surveyors in the district in which their works are situated. The number and size of the rivet bars should be stated on Form A and the form should be accompanied by the steel maker's certificate endorsed to the effect that it relates to the bars from which the rivets are to be made.

On receipt of Form A and the steel maker's certificate, the Surveyor should inspect the bars and select test pieces. The number of test pieces should be determined by the number of cut bars and by paragraph 187 of the Instructions. The tensile strength and elongation should be in accordance with paragraph 188(d). In addition, sulphur prints should be taken from the bars in order to ensure that the material is free from sulphur segregates and other non-metallic substances concentrated in the core.

The tests of the rivets prescribed in paragraph 191 should preferably be carried out at the works at which the boilers or pressure vessels are to be made, but in the case of shipment orders they are to be carried out at the rivet makers' works.

On completion of the order the rivet makers should record on Form B the sizes and weights of the rivets and the firms to whom the rivets have been despatched. Forms A and B, the steel maker's certificate and Form Surveys 24 upon which the results of the tests of the bars are reported and approved should be attached to the file and submitted to headquarters. Duplicate copies of Forms A and B may be retained for local records.

To facilitate identification of rivets made under the foregoing procedure, The Rivet, Bolt and Nut Company emboss the letters "M.T." on the rivet head and North-West Rivet, Bolt and Nut Factory mark their rivets similarly using the letters "M.O.T."

Where the rivets are to be used in boilers and pressure vessels which are being constructed under the Ministry's survey and for which the usual fees are paid, a separate fee need not be charged for the testing of rivet bars and rivets.

#### CERTIFICATE OF INSPECTION (TESTING MACHINES)

22. Machines used by steel makers and others for testing material intended for hulls, boilers, machinery, etc., under the Ministry's survey are to be stripped for examination and verified by the Ministry's Surveyors at intervals not exceeding twelve months. Standard steel measures and pressure gauges are provided by the Ministry for this purpose. Where proving rings are used for verification they should be calibrated by the National Physical Laboratory at intervals of not more than two years. Each ring should be accompanied by its test certificate.

In the case of testing machines not previously verified by the Ministry's Surveyors, the Surveyor must submit full particulars to the Engineer Surveyor-in-Chief before proceeding with the verification.

The machine should be stamped, at the initial verification in a conspicuous place, in the following manner:

M.  T.

VERIFICATION  
(DATE)

(SURVEYOR'S INITIALS)

At each annual verification the Surveyor should report the relevant particulars to the Engineer Surveyor-in-Chief.

On application by the owners of the machine and on payment of the appropriate fee, a Certificate of Inspection will be issued by the Ministry indicating the results of the Surveyor's inspection.

Machines used for testing blocks, lifting hooks and lifting gear intended for lifeboats and repaired chains for steering gears, and for testing electrically welded specimens for the approval of electrodes, are to be examined and verified generally in the same way.

## APPENDIX VI

### Circular 1704

(Revised February 1954)

## The Survey of Passenger Ships

### Ships of Class VI

## INSTRUCTIONS TO SURVEYORS

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*This Circular presents in a convenient form the standards to be met by small vessels in order to qualify for Class VI passenger certificates. It supersedes Circular 1704 published by the Board of Trade in August, 1935, and covers the requirements prescribed by the Statutory Rules made by the Minister of Transport and Civil Aviation under the Merchant Shipping (Safety Convention) Act, 1949.*

#### GENERAL

1. *Assignment of Limits.* Vessels holding Class VI passenger certificates are allowed to ply only in summer\* and in fine weather on short excursions to sea within specified limits. In no case may the limits be such that the vessel will at any time be more than 3 miles from shore or more than 15 miles, exclusive of any smooth water, from the point of departure. In no case will the certificate be issued for more than 250 passengers.

These vessels are only allowed to ply from sunrise to sunset unless they carry navigation lights. Ships equipped with navigation lights in accordance with the Collision Regulations† are allowed to ply from one hour before sunrise to one hour after sunset.

It will be the Surveyor's duty under the Principal Officer concerned to fix the limits within which the vessel may ply, having regard to its capabilities and the conditions likely to be met. The limits should be so fixed that it will be possible for the vessel to obtain assistance if a breakdown occurs, or to return to shore or shelter if the weather suddenly becomes threatening.

In fixing the limits the Surveyor should therefore have particular regard to the usual tide and weather conditions, the seaworthy qualities of the vessel, including its freeboard and sheer, the number of passengers to be carried, and the speed, construction, condition and general suitability of the vessel for the intended service.

For the guidance of Principal Officers and Surveyors Class VI vessels have been divided into 3 groups, and maximum plying distances allotted to each group. Principal Officers have discretion however, where in their opinion it is safe, to increase these distances in exceptional cases, such as where part of the trip lies within smooth waters. The three groups are as follows:

- (i) Open boats carrying not more than 100 passengers. These boats may be allowed to ply up to 5 miles from the starting point. Small boats may, at the Surveyor's discretion, be limited to a plying distance of 3 miles from the starting point.
- (ii) Boats fitted with a foredeck not less than 8 feet in length and a W.C., limited to a maximum of 100 passengers. These boats may be allowed to ply up to 10 miles from the starting point.
- (iii) Fully decked boats limited to a maximum of 250 passengers. These boats may be allowed to ply up to 15 miles from the starting point.

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\* Summer is defined for this purpose as the period between 1st April and 31st October inclusive, but when Good Friday falls earlier than 1st April the certificate may be issued to take effect on and from that day.

† The Collision Regulations (Ships and Seaplanes on the Water) and Signals of Distress (Ships) Order, 1953. (Statutory Instruments 1953 No. 1557, price 8d. net).



Vessels may be allowed to hold Class VI passenger certificates for adjacent limits, but must not carry passengers from one Class VI plying limit to another Class VI plying limit. Vessels may, however, subject to the discretion of Principal Officers, embark passengers in smooth waters and then proceed within Class VI limits, or vice versa, provided the vessel holds the appropriate passenger certificates.

Class VI vessels may land passengers at intermediate points subject to the Principal Officer being satisfied that this can safely be done, having regard to tide and weather conditions. The intermediate landing points will be shown on the passenger certificate.

It is left to the discretion of the Principal Officer to allow limits involving the rounding of prominent headlands, but normally only decked vessels with twin screws will be permitted to do so. Attention must be paid to the availability of safe landing places in the event of the ship getting into difficulties.

**2. Issue of Surveyor's Declaration.** The Surveyor who conducts the survey must be satisfied that the hull, machinery, life-saving and fire extinguishing appliances and other equipment are sufficient for the service intended, having regard to the conditions of wind and weather to which the vessels may be exposed and that proper precautions have been taken to guard against the occurrence of fire or explosion. Only after being properly satisfied on these matters, as amplified in the remainder of these Instructions, will the Surveyor issue his Declaration to the owner or his representative.

Before the Declaration is issued the vessel should be tried in the Surveyor's presence for handiness in manoeuvring, going ahead, stopping and going astern. The Declaration must state the limits within which the vessel may ply.

The Declaration will not be withheld solely because there is no beach inspector or similar official at the place where the vessel is intended to ply, but it is desirable that there should be an official to control the conditions of embarking and landing, to check numbers, and to superintend generally. The co-operation of such officials should be invited, and the Surveyor should state in his Declaration whether there is such an official at the place where the vessel is intended to ply.

After receiving the Declaration, the owner or his representative should send it within 14 days to the Assistant Secretary, Marine Safety Division, Ministry of Transport and Civil Aviation, Berkeley Square House, W.1 (see Section 273 of the Merchant Shipping Act, 1894).

Declarations for vessels propelled in any manner not covered by these Instructions must in all cases be withheld until the approval of the Ministry has been obtained.

**3. Men in Charge.** At least two persons should be employed in these vessels. The man in charge should be a person who has had sea experience and understands how to handle the vessel in a seamanlike manner; and the engineer, whether he is the man in charge or not, should be experienced in his work and able to demonstrate to the Surveyor that he is competent to take charge of an engine.

**4. Form of Undertaking.** The owner of a vessel requiring a Class VI passenger certificate is required to sign an undertaking in the following form:

"I hereby undertake that, if the Ministry of Transport and Civil Aviation issue a passenger certificate for my passenger launch;

- (1) the vessel will be used to carry passengers only when the weather is settled and the sea is calm;
- (2) a report will immediately be sent to the nearest Ministry Marine Surveyors' Office should the vessel suffer any damage affecting her seaworthiness or her efficiency either in her hull or in any part of her machinery;
- (3) the other conditions stated on the certificate and any regulations or instructions of the Local Authority will be at all times complied with;
- (4) the vessel will be kept clean and free from oil refuse, and the fire extinguishing equipment will be kept in an efficient condition;
- (5) no loose can of petrol will in any circumstances be carried in the vessel;
- (6) if either the man in charge or the engineer is changed I will notify the Surveyor;
- (7) the vessel will not be used for towing any other boat or craft except in cases of emergency.

I understand that the certificate may be cancelled at any time by the Ministry if any of these conditions is infringed.

Signature .....

Address .....

Date .....

Signature of Witness....."

The form of undertaking (Form Surveys 134) is to be signed and witnessed before the Surveyor's Declaration is handed to the owner for transmission to the Ministry.

**5. Fees and Application for Survey.** For the survey of a vessel for a Class VI passenger certificate the fee is as follows:

For a vessel of 50 tons gross and under:

If the certificate is for not more than 36 passengers. . . . . £9.0.0

If the certificate is for more than 36 passengers . . . . . £13.0.0

For vessels of over 50 tons gross:

For a vessel of over 50 tons gross and not exceeding 100 tons gross . . . . . £24.0.0

For a vessel of over 100 tons gross and not exceeding 300 tons gross . . . . . £36.0.0

Application for survey should be made on Form Surveys 6 to the nearest Ministry Marine Surveyors' Office.

#### HULL AND CONSTRUCTION REQUIREMENTS

**6. (a) Submission of Plans.** On first survey, particulars should be submitted to the Chief Ship Surveyor showing construction, materials and scantlings of the hull. The plans should also show the passenger accommodation and, if this is in an enclosed space, particulars of the entrances and exits.

**(b) Watertight Subdivision.** If the owner desires to carry more than 150 passengers the ship must comply with the watertight subdivision requirements of Part II of the Merchant Shipping (Construction) Rules, 1952,\* as they apply to ships of Class VI.

**(c) Bulkheads.** In vessels fitted with internal combustion engines, whether constructed of wood or steel, the bulkheads separating the machinery space from the accommodation spaces must be made of steel and insulated so as to provide an effective fire division. In open wooden boats, however, these bulkheads may be of wood subject to their being adequately constructed and lined as required in paragraph 8.

**(d) Sidescuttles** fitted below the deck must be of a non-opening type.

**(e) Height of Sides and Rails.** In open vessels the top of the gunwale, covering board or wash strake, or the upper edge of the half deck at side as the case may be, should be not less than 30 inches above the flooring boards in the case of vessels 20 feet in length or less, and not less than 36 inches in the case of vessels 40 feet in length or more. For lengths between 20 and 40 feet the height should be in proportion. When the height from the top of the covering board is less than that stated above, a wash-board or rail is to be fitted above the covering board in such a position that the top of the rail is at least the required height above the flooring boards. Decked motor launches plying in Class VI limits are to be provided with bulwarks or rails not less than 3 feet 3 inches in height and the rails should not be more than 9 inches apart unless strong netting is provided.

**(f) Fore Deck and Water Closets.** A vessel plying more than five miles from the starting point must have a foredeck not less than 8 feet in length and an efficient water closet. The Surveyor must be satisfied that the W.C. gives reasonable privacy, is large enough and has adequate headroom and ventilation. Efficient means must also be provided to prevent the accidental admission of water through the discharge.

In vessels carrying more than 150 passengers, at least 2 W.Cs. are to be fitted.

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\* Statutory Instruments 1952 No. 1948, price 3s. 0d. net.

(g) *Freeboard.* When the vessel is loaded with weights representing the full number of passengers and crew at 140 lb. for each person, and when all the necessary fuel is on board, the clear height of side above water, at the lowest point, is not to be less than 15 inches for vessels 20 feet in length or less, and 30 inches for vessels 60 feet in length and over. For lengths between 20 and 60 feet the height should be in proportion. The length should be measured from the forward side of the stem to the after side of the stern post, and the clear side should be measured to the top of the covering board or to the top of the wash strake, if one is fitted above the covering board. If, however, a half-deck is fitted, the clear side should be measured to the top of the deck at side or to the top of the gunwale, whichever measurement gives the smaller freeboard. In decked boats the freeboard should be measured from the top of the deck at side.

(h) *Flooring* must be provided throughout the vessel. It must be removable to allow for cleaning and inspection, and must allow rapid drainage of water to the bilges. Drain plugs in the skin of the vessel will not be permitted.

(i) *Position of Helmsman.* Provision must be made in all vessels, whether or not fitted with raised decks or similar obstructions, for the helmsman to have a clear view for safe navigation.

(j) *Awnings* must not be fitted.

## MACHINERY REQUIREMENTS

### 7. Submission of plans

(a) *General Arrangement.* On first survey, particulars of the general arrangement of machinery and fuel tanks in the vessel, the engine casing and means for the prevention of spread of oil from the machinery space and the capacity of the fuel tanks must be submitted to the Engineer Surveyor-in-Chief.

(b) *Engines of 150 B.H.P. or over.* If internal combustion engines are of 150 B.H.P. or over per unit, the engines and shafting of new vessels are to be constructed under the Ministry's survey after approval of the designs by the Engineer Surveyor-in-Chief. The survey must include tests of the material for the principal parts of the machinery, including the shafting, and hydraulic tests of the cylinder liners to at least 100 lb. per square inch and of the water passages of the cylinders, covers, etc. to a pressure of at least 30 lbs. per square inch.

(c) *Engines of less than 150 B.H.P.* Internal combustion engines of less than 150 B.H.P. must be of a design accepted by the Ministry. Survey during construction will not ordinarily be required, but makers should give guarantees covering the tensile strength and chemical analysis of the material of forged or stamped steel crank shafts and gear shafts and the hydraulic tests of water spaces. Surveyors are, from time to time, to visit works where engines used in passenger launches are made to satisfy themselves regarding the standard of production and testing methods; they may require Brinell or other hardness check tests of the shafts at any time. In the case of crank shafts of accepted special cast material, physical tests at the makers' works are to be witnessed of each batch of shafts produced for engines under the Ministry's survey.

(d) *Non-corrodible shafting.* Propeller shafts are to be of non-corrodible metal, and in all cases the material for propeller shafts, and other shafts of bronze, is to be tested.

(e) *Vessels requiring twin screws.* A vessel over 60 feet in length going more than 5 miles from the starting point should be fitted with twin screws. If for special reasons the owner or builder does not propose to fit twin screws, the case should be submitted for consideration by the Engineer Surveyor-in-Chief.

(f) *Machinery Fencing.* The machinery including the shafting must be fenced where necessary so as to protect persons in the vessel from injury.

(g) *Running Trials.* After installation of the propelling machinery, running and manoeuvring trials under service conditions are to be witnessed by the Surveyor before the Declaration is issued.

8. *Motor Compartment: Construction, Ventilation, etc.* If the motor or fuel tanks are situated below deck and oil of a flash point lower than 150° F. is used the motor and fuel tanks must be enclosed in separate watertight and well ventilated compartments, in which no stove or other similar heating apparatus is to be placed. Each compartment must be furnished with at least two cowl ventilators one of which is to



be led well down into the space to prevent accumulation of vapour in the lower part. Any enclosed space within which a motor or fuel tank is placed must be ventilated in this manner irrespective of whether heavy or light oil is used as fuel.

In open vessels, the spaces occupied by the motor and fuel tank should, preferably, be at the after end of the vessel and separated from the space allotted for the accommodation of passengers and crew by a substantial bulkhead as high as the seats and watertight up to at least half its height to prevent the spread of oil to the passenger or crew space. If it is desired to place the motor amidships or forward, either arrangement may be allowed provided that a bulkhead or casing, formed in the manner stated, is placed between the motor space and the passenger or crew space.

Motors must be covered in, and the compartments or casings containing them must be constructed of steel or, if of wood, lined with asbestos sheeting  $\frac{1}{4}$  inch in thickness covered with sheet steel. (For bulkheads separating the machinery space from the accommodation spaces, see paragraph 6(c)).

If the vessel is of wood, a metal tray which can readily be cleaned and is of suitable depth must be fitted under the motor: the bilges must be protected against saturation by oil.

9. (a) *Nature of Fuel.* Internal combustion engines must be driven by heavy oil, paraffin or other similar fuel and not by petrol, but where necessary to facilitate starting, a small quantity of petrol, in general not exceeding two gallons per engine, may be carried, provided it is contained in a closed tank permanently connected to the engine.

(b) *Fuel Tanks.* The fuel tanks must be substantially constructed of suitable material, no larger than is necessary and must be securely fixed in position. No part of the fuel tanks or their fittings is to depend on soft solder for tightness. Fuel tanks and their connections must be perfectly oil-tight and tested by hydraulic pressure to a head of water of at least 15 feet. Particulars of tanks and fittings are to be submitted to the Engineer Surveyor-in-Chief if a pressure feed system is employed.

(c) *Tray for Fuel Tanks.* A suitable metal or lead-lined tray from which any accumulation of oil can be readily removed must be fitted under each tank.

(d) *Arrangements for Filling and Position of Fuel Tanks.* In order to minimise the risk of fire and explosion, the arrangements for filling the fuel tanks are to be such that oil or spirit will not spill or overflow either into the compartment containing the tanks or any other part of the vessel. Arrangements must also be made for discharging overboard the vapour which is displaced when the tanks are filled up. If the tanks are filled through the deck, the woodwork surrounding the inlet pipe must be covered with sheet metal to prevent it becoming saturated with oil or spirit. A beading must be fitted at the edge of the sheathing to prevent the oil or spirit from spreading.

A properly secured wire-gauze diaphragm or tube strainer, which can easily be taken off for cleaning and examination, is to be fitted to each filling inlet and at each vapour or oil outlet on the tanks, and the filling pipe or orifice must have a suitable screwed cap.

Fuel tanks should not, as a rule, be fitted in the motor space, but should be placed in a separate compartment, or on deck, remote from the motor; a modification of this requirement will be granted only where the flash point of the fuel exceeds 150° F., or in the case of small open vessels, where the machinery is fitted at the after end.

No loose cans of fuel oil or spirit are to be carried, and the fuel tanks must not be filled when passengers are on board.

(e) *Pipe Arrangements.* The pipe conveying the fuel must be of seamless material made with easy bends and metal to metal joints. A cock is to be fitted at each end of the fuel pipe, and no joint is to depend on soft solder for tightness. The joints and couplings are to be readily accessible. It must be possible to close any fuel tank outlet cock readily from a position outside the compartments containing the tank and the motor. This position must be such that it is not likely to be cut off in the event of fire in those compartments.

On engines using paraffin as fuel the air inlet pipe to the carburettor must be fitted with a wire-gauze diaphragm and so arranged as to satisfy the Surveyor that there will be no danger of fire or explosion from escaping vapour when the engine is stopped, or from flame should a back-fire occur.

As a general rule exhaust pipes should not be carried through enclosed passenger spaces. No unjacketed exhaust pipe will be permitted in any enclosed motor or other room. If the temperature of the pipe exceeds 400° F. under full working conditions it must be water-cooled.

10. *Pumping and Bailing Arrangements.* Means for keeping the vessel clear of water must be provided as follows:

Type and length of vessel		Power Pumps	Hand Pumps	Bailers
All types over 60 feet . . . . .		1 May be worked by main engine	1 Rotary or semi-rotary	—
Decked vessels up to 60 feet . . . . .		—	1 Rotary or semi-rotary	—
Partially decked vessels up to 60 feet . . . . .		—	1	2
Open vessels over 40 feet and up to 60 feet . . . . .		—	1	2
Open vessels up to 40 feet	If plying beyond 3 miles from starting point . . . . .	—	1	2
	Plying up to 3 miles from starting point . . . . .	—	—	2

One bailer and one bucket may be accepted in lieu of two bailers.  
Bilge pipes should, in general, be not less than 1½ inches in diameter.  
If in special circumstances any departure from the foregoing is desired, the case should be submitted to the Engineer Surveyor-in-Chief.

PASSENGER ACCOMMODATION

11. (a) *Open Launches.* The forward extremity of the space available for the passenger accommodation is to be determined by the Surveyor, with due regard to the proper stowage of the anchor and cable and to any other necessary equipment in the bow of the vessel, and the length is to be measured from this point to the foreside of the bulkhead separating the motor space from the passenger space. If the motor is placed amidships (see paragraph 8) an additional space may be available for passengers between the after bulkhead of the motor space and a position near the stern of the vessel to be determined by the Surveyor as suitable, having due regard to the steering arrangements and fuel tank space.

The breadths are to be measured at suitable intervals to the back of the side benches or to the inside of the gunwale or to the inside of the half deck (where fitted) whichever measurement is least.

The spaces abreast of the motor may be included in the passenger measurements if the motor is enclosed by a casing or longitudinal bulkheads constructed in accordance with paragraph 8 and if the distance between the sides of the casing or bulkheads and the back of the seats is at least three feet.

The number of passengers allowable by area is found by dividing by four the area in square feet of the clear space measured as above. Allowance should be made for the crew in the area measurements. The number allowable by seating is found by dividing the length in feet of each continuous fixed seat by 1.5. Seating on buoyant apparatus is to be computed separately. The number allowable for each part is the lesser of the numbers given by area and by seating.



In open launches the number of passengers is not to exceed two per foot of the ship's length (the length is defined in paragraph 6(g)). In any case the maximum number of passengers allowable for an open launch is 100.

(b) *Decked Launches.* The forward extremity of the space available for passenger accommodation is to be determined as described above for open launches, and the clear area of this space is to be obtained by deducting all encumbrances such as skylights, companions, machinery casings, navigating spaces, lifeboats and ventilators.

The maximum number of passengers that may be allowed is to be ascertained by using the divisor six for the area of the deck in square feet and the divisor nine for the area in square feet of the saloon or cabin floor below deck. Only one saloon below deck should be included in the passenger measurements, except that where the vessel has an appropriate standard of watertight subdivision, two saloons may be included if of moderate size, subject to Headquarters approval. The number of passengers to be allowed for each part must not, however, exceed the number for which seating accommodation is provided, and this number should be found as indicated above. In no case may more than 250 passengers be allowed.

(c) In all vessels the seating must be so arranged that there will be no serious obstacle to prevent a person from passing forward and aft quickly in case of emergency.

In all cases Form Surveys 8a showing measurements of the passenger accommodation should be completed by the Surveyor and forwarded to Headquarters.

#### STABILITY

12. An inclining experiment must be carried out to determine the elements of stability. Unless particulars of the position of the transverse metacentre at various draughts are available, the experiment should be carried out with the vessel loaded with weights to represent the fully laden condition. A calculation showing the transverse metacentric height and the angle of heel which would occur with two-thirds of the passengers distributed on one side of the ship and one-third on the other side should be forwarded to the Chief Ship Surveyor. Each passenger should be represented by a weight of 140 lb.

In decked vessels the passengers should be taken as congregated at 3 square feet each on the uppermost deck or decks to which they have access and the centre of gravity of the passengers at 2 feet 6 inches above the deck.

In open boats, the centre of gravity of the passengers should be taken at 1 foot above the seat.

In no case should the Surveyor certify a vessel for any number of passengers unless he is satisfied that the vessel has sufficient stability and freeboard to carry that number safely.

#### LIFE-SAVING APPLIANCES

13. In all vessels 70 feet and upwards in length the life-saving appliances must comply with Rule 9 of the Merchant Shipping (Life-Saving Appliances) Rules, 1952.

All vessels of less than 70 feet in length must be provided with buoyant apparatus, preferably buoyant deck seats, and with lifebuoys, in accordance with the following sub-paragraphs:

(a) A vessel plying not more than three nautical miles from its starting point must be provided with buoyant apparatus sufficient to support at least 40 per cent. of the total number of persons which the ship is certified to carry, together with lifebuoys not less in number than is specified in sub-paragraph (c) below, so, however, that the buoyant apparatus together with the lifebuoys are in all cases sufficient to support at least 70 per cent. of the total number of persons which the ship is certified to carry.

(b) A vessel plying more than three miles from its starting point must carry buoyant apparatus sufficient to support at least 60 per cent. of the total number of persons which the ship is certified to carry, together with lifebuoys not less in number than is specified in sub-paragraph (c), so, however, that the buoyant apparatus together with the lifebuoys are in all cases sufficient to support the total number of persons which the ship is certified to carry.



(c) Minimum number of lifebuoys:

Vessels not over 30 feet in length . . . . .	2
Vessels over 30 feet and not over 35 feet . . . . .	4
Vessels over 35 feet and not over 40 feet . . . . .	6
Vessels over 40 feet and not over 50 feet . . . . .	8
Vessels over 50 feet and not over 70 feet . . . . .	10

On vessels not exceeding 30 feet in length lifebuoys may be allowed instead of buoyant apparatus at the discretion of the Principal Officer, who should take into consideration the plying limits assigned.

Each lifebuoy is to be regarded as buoyancy for two persons.

All the appliances are to be so stowed as to be immediately ready for use, and should not be lashed down.

Every vessel must carry at least two buoyant smoke signals capable of giving off orange-coloured smoke.

FIRE APPLIANCES

14. Fire Extinguishing Appliances

(a) Every decked vessel must be provided with appliances whereby a powerful jet of water can be rapidly brought to bear upon any part of the vessel.

(b) Every decked vessel must be provided with at least one portable fluid fire extinguisher of accepted type in each of the passenger spaces above the upper deck and with at least two such extinguishers in each of the crew spaces and of the passenger spaces below that deck.

(c) Every decked vessel must be provided in the machinery space with a fire hydrant and fire hose fitted with a nozzle suitable for spraying water on oil.

(d) Every decked vessel must be provided in the machinery compartment with one froth fire extinguisher of at least 10 gallons capacity or one carbon dioxide fire extinguisher of at least 35 lb. capacity, and also with two 2 gallon froth fire extinguishers.

In decked motor vessels up to and including 70 feet in length where the fitting of a 10 gallon extinguisher may be impracticable a total of four 2 gallon froth fire extinguishers may be carried for the machinery space or, if the space can be rapidly and completely closed, two of the four extinguishers may be of a type discharging carbon tetrachloride or other substance for quenching oil fires.

(e) Every open vessel must be provided with:

- (i) at least two buckets or bailers, or a hand pump with a hose,
- (ii) a scoop and a receptacle containing a suitable quantity of sand or other dry material capable of quenching oil fires,
- (iii) froth fire extinguishers and carbon tetrachloride or equivalent type fire extinguishers of accepted types in accordance with the following scale:

Length of Ship	Carbon tetrachloride or equivalent type	Froth type and minimum capacity
Not exceeding 30 feet . . . . .	2	1 One gallon
Exceeding 30 feet but not exceeding 50 feet . . . . .	2	2 One gallon
Exceeding 50 feet . . . . .	3	2 Two gallons

(f) All extinguishers and any valves by which they are operated must be easily accessible and so placed that they will not readily be cut off from use by an outbreak of fire.

## 15. Fire Pumps

(a) Every decked vessel must be provided with at least one power fire pump of ample capacity.

(b) Every decked vessel must be provided with an additional fire pump, hand or power operated, connected to the water service pipes. Such pump and its source of power, if any, must not be placed in the same compartment with the pump required by sub-paragraph (a) above, and may be a manual pump of the rotary type of suitable capacity, situated on deck in a position away from the engine room. The sea suction valve must be capable of being controlled from outside the machinery space.

(c) Every open vessel decked in way of the engine room must be provided with a hand pump and with a fire hose with a nozzle suitable for spraying water on an oil fire. This pump must be situated outside the engine room.

16. *Water Service Pipes, Hydrants, Fire Hose, etc.* Every decked vessel must be provided with water service pipes, hydrants and fire hoses so arranged that at least one jet of water may be directed into any part of the ship. Fire hose should, in general, be not less than  $1\frac{1}{4}$  inches in diameter.

17. *General.* The vessel must be kept free from waste oil. It must be seen that all vapour pipes and wire-gauze diaphragms are in order and that fuel pipes and connections are oil-tight. Fuel tanks should be removed for thorough examination and tested for tightness periodically.

It must be seen that the men in charge understand how to use the fire extinguishers.

At least one fire extinguisher must be tested annually and, when practicable, the men in charge should be present when the test is made. If the extinguisher is of the pressure type, the Surveyor should satisfy himself as to its sufficiency for the pressure which it may have to sustain; for this purpose the charge must be withdrawn. Suitable spare charges for all portable fire extinguishers must be carried.

Surveyors should advise owners and men in charge of the purpose and use of the different types of extinguishers. For example, in small closed compartments the outlets of which can be closed or partly closed, carbon tetrachloride or carbon dioxide extinguishers will be most effective in dealing with oil fires. In open or partly open spaces froth extinguishers will be most effective against oil fires. In closed passenger spaces where woodwork may be set on fire extinguishers discharging water or froth extinguishers will be suitable.

## OTHER EQUIPMENT

18. Every vessel must have means of making sound signals in accordance with the Collision Regulations and the Instructions as to the Survey of Lights and Sound Signals. It must also be equipped with navigation lights as required by the Collision Regulations if it is to ply outside the hours of daylight (see page 2).

A compass, anchor and cable, boat hook, painter, and a heaving line must also be carried.

Open launches must be provided with at least three oars and rowlocks.

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